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JOURNEY TO THE GUGHÉ HIGHLANDS (SOUTHERN ETHIOPIA), 1948–9; BIOGEOGRAPHICAL RESEARCH AT HIGH ALTITUDES

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(With Plates 3 to 28, folding map, and 7 text-figures.)

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INTRODUCTION.

> Many of the happiest days of my life have been spent in the uplands of Abyssinia, enjoying the ever varying scenery of mountain, valley and plain, looking at the lovely flowers, plants, and trees, the birds with their gorgeous plumage, the animals and the butterflies, moths and insects, many of them being unknown in other countries. No day ever seemed to be too long, and I know of no country that would repay the botanist, naturalist, geologist or artist better, than a year passed collecting and studying the varied objects to be met with.—*A. B. Wylde, Modern Abyssinia*, 1901, p. 3.

From August 1948 to February 1949 I made the second of two natural-history exploratory journeys in Ethiopia (Abyssinia)*. This venture was financed mainly by grants from The Royal Society, the Trustees of the Percy Sladen Memorial Fund, the Managers of the Francis Maitland Balfour Fund (Cambridge University), and by an Award from the Leverhulme Research Trustees, one of whose Fellowships I had previously held while leading the British Museum (Natural History) Expedition to South-West Arabia in 1937–8. My first journey, the ' Entomological Expedition to Abyssinia ' (Scott, 1927) took place 22 years earlier, from September 1926 to January 1927, in company with Professor J. Omer-Cooper, M.A., F.L.S. We were then assisted by grants from three of the same sources, namely The Royal Society (Darwin Fund), the Percy Sladen Trustees and the Balfour Fund Managers. At the outset I would express my cordial thanks for the generous financial aid granted me by these several bodies on both occasions; while acknowledgments for personal hospitality and help are given below (p. 166).

MOTIVES FOR THE TWO EXPEDITIONS.

On both journeys my main purpose was to collect insects at high altitudes. Nor did I neglect other invertebrate animals or plants. Moreover, on both expeditions I noted all I could of the countryside and its inhabitants, their customs and occupations. In this Report I have tried to relate these subjects of human interest to the topography, vegetation and climate, illustrating them from my series of several hundred photographs, many of which were taken under very difficult physical and atmospheric conditions.

As to its principal aim, the joint Expedition of 1926–7 greatly increased our knowledge of the fauna. Some 48 Reports, nearly all on invertebrate animals (principally insects), have appeared in two parallel series, edited respectively by myself and Professor Omer-Cooper, besides other articles published independently †.

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* Regarding the use of these two names see Appendix B (p. 175).

† See Bibliography (1), p. 178.

Entomologically my purpose on the earlier Expedition was broad. Beyond wishing to learn something of the insects living under temperate climatic conditions at 8,000 feet and higher, I had planned little investigation of particular problems before my arrival in the country in 1926. I proposed to visit the mainly coniferous forest of Jem-Jem* (8,000–9,000 feet), about 45 miles west of Addis Ababa, where I eventually spent three weeks, and the extinct crater of Mt. Zuquāla (9,900 feet), on the rim of which, above the sacred crater-lake, we camped for a week. But I had not thought of Mt. Chillālo, the scene of my most interesting discoveries, till from the highest point of Zuquāla I saw its heath-topped 13,000-foot mass looming 47 miles to the south-east. My short mule-treks in January 1927 to the Muger Valley and Debra Libanos, north of Addis Ababa, and from Diré Dawa to Harar (then still without a road for vehicles) were also devised on the spur of the moment.

Furthermore, though in 1926–7 I concentrated on terrestrial insects of forests and mountains, leaving the aquatic fauna to my colleague, I collected as far as possible insects of all Orders. The insects attached to tree-euphorbias were the only narrower faunistic unit of which investigation was planned beforehand. But while these proved disappointing (especially when compared with the remarkable euphorbicolous insects of North-West Africa and the Atlantic Islands), I stumbled accidentally on the interesting assemblage of forms associated with giant lobelias mentioned below (p. 102).

During the recent Expedition, on the other hand, my entomological and biogeographical exploration was designed beforehand with a more limited purpose. Following up the results of the earlier Expedition, I wished to investigate further the forms inhabiting the separate high mountains rising from the general level of the plateaux to heights between 10,000 and over 13,000 feet.

Biogeographical Considerations.

Research on the Ethiopian mountains related to research on the mountains of East Africa: a study of the insects restricted to these isolated high mountains and massifs has led me at any rate to an *interim* conclusion, applicable also in greater or less degree to other groups of animals and to plants. The high-mountain forms appear to be either (A) 'relicts', i.e. descendants of stocks far more widely spread in former periods when the climate of the surrounding lower altitudes was cooler and moister than now (see pp. 90, 97), or (B) later-evolved species closely allied to those of the surrounding lower levels, but which have developed 'montane' characters (see p. 104). This theme is discussed further below. (Note: in this Report the terms 'high-mountain' or 'montane' are used of animals and plants, rather than 'alpine'. The opinion was voiced by Dr. W. B. Turrill† that 'alpine' is a misleading term when applied to the Ethiopian and East African mountains, and is best restricted to the fauna and flora of the European Alps or to those of mountains of a similar type. The terms 'alpine' and 'subalpine' have, however, been applied by Dr. Uvarov and other writers to the African mountains, and are freely used by Dr. Jeannel. In the publications of the Swedish East Africa Expedition 1948 the term 'afro-alpine' is employed (Hedberg, 1951).

My *interim* conclusion about the origin of the African montane animals and plants, though reached independently, agrees on the whole with the views set forth by Dr. Jeannel in his recent book (1950 *a*, chaps. xiii, xiv). Nor should my work on the Ethiopian mountains be considered alone, but as part of a series of biogeographical explorations directed towards discerning the general distributional pattern of certain groups of organisms ranging over all the high mountains of eastern Africa.

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* Not to be confused with the large tribal territory of the same name in Sidāmo Province, south-east of Lake Abaya.

† In the discussion following Mr. Schelpe's lecture on the Vegetation of Mt. Kenya at the Linnean Society on 12 October 1950.

It is unnecessary to enumerate all these natural-history explorations. But special account must be taken of SJÖSTEDT'S Expedition to Mts. Kilimanjaro and Meru in 1905–6 (Sjöstedt, 1910) ; the journey of Dr. JEANNEL and the late Charles ALLUAUD to Mts. Kilimanjaro and Kenya in 1911–12 (Alluaud et Jeannel, 1912) ; the Swedish Expedition to Mt. Elgon on 1920 (general account, LOVÉN, 1921) ; the part played by Belgian naturalists in the unveiling of Ruwenzori, specially the botanical work of Professor HAUMAN and the entomological work of the late L. BURGEON in the large team of explorers assaulting the range from its western side in 1931 and the following years (general account, Count DE GRUNNE, 1937) ; the MISSION SCIENTIFIQUE DE L'OMO, 1932–3, when visits by Dr. Jeannel and M. P.-A. Chappuis to Mts. Elgon and Kinangop (Aberdare Mts.) were combined with the journey of Professor C. Arambourg to the deposits of fossil giant mammals near the lower reaches of the Omo (Jeannel, 1934 ; and *Mission de l'Omo*, 1935–47) ; and the BRITISH MUSEUM (NATURAL HISTORY) RUWENZORI EXPEDITION, 1934–5, led by the late Dr. F. W. Edwards, F.R.S., and by Dr. G. Taylor, in which Ruwenzori, the Aberdare Mts., Mt. Elgon and the Birunga (Virunga) Mts. were visited (see vol. i, no. 1, 1939). Nor should the writings of the late G. L. R. HANCOCK and others on particular parts of Elgon and Ruwenzori be forgotten (Hancock and Soundy, 1931 ; Fishlock and Hancock, 1933). Even as I write a part of the Results of the SWEDISH EAST AFRICA EXPEDITION 1948 has come to hand, a work illustrated by beautiful photographs on the vegetation belts of the East African mountains (Hedberg, 1951). A general (but not exhaustive) bibliography of the first explorations, geology, glaciers, and natural history of these mountains has been given by Dr. Jeannel (1950 *a*, pp. 247–50). Hedberg also gives a full bibliography on the vegetation-belts, including the important works of R. E. and TH. C. E. FRIES. Many items in the bibliographies cited are not repeated *in extenso* in the present Report, as I have not attempted a historical review of the zoological and botanical exploration of the mountains of eastern Africa. Moreover, I can do no more than mention the valuable work of Mr. R. E. MOREAU on " Africa since the Mesozoic ", published as recently as February 1952, but included in my bibliography.

As the primary purpose of the BÒTTEGO Expedition to the Omo (1895–7) was geographical exploration, and its zoological results, though important, were subsidiary, I have included it below (p. 108) under previous exploration of the Gughé highlands.

Two major enterprises conducted in recent years by Professor ZAVATTARI, the MISSIONE BIOLOGICA NEL PAESE DEI BORĀNA (1937) and the MISSIONE BIOLOGICA SAGAN-OMO (1939) assuredly deserve mention. The field of both lay in Southern Ethiopia, though far south of the Gughé mountains, in lower and drier country. The second of these missions solved the problem of the present state of Lake Stefanie (see bibliography under titles of these Missions ; also Zavattari, 1940, 1942, 1946).

Comparative poverty of the high mountains of Ethiopia : in the drawing of this composite biogeographical picture my rôle has been to sketch in parts of a vast area previously almost blank. To have achieved this compensates for the arduous conditions of travel and the relative fewness of the high-mountain species rewarding a collector's efforts—disadvantages to be set against the peculiar interest, scenic and otherwise, of the country. The fauna and flora of high Ethiopia as a whole are indeed varied and interesting, but the uppermost zones of its loftiest mountains are far poorer in this respect than those of the high East African mountains.

A single instance will exemplify the relative poverty of the high Ethiopian mountains. On the mountains of East Africa one of the most spectacular features is the wealth of giant lobelias and arborescent senecios. Yet in Ethiopia only two species of the former occur (*Lobelia rhynchopetalum*, from the highest altitudes, confined to Ethiopia, and the widespread *L. giberroa*, from lesser heights) while the arborescent senecios are not represented in the country at all[*].

The far richer material obtained by the other expeditions mentioned (as also the advantage in scenic background and amenities) is partly correlated with the much higher altitudes available to collectors in the eastern and central African mountains. Kilimanjaro reaches 19,320 feet, the Ruwenzori range 16,794, Mt. Kenya 17,040, Mt. Elgon 14,140[†]. The three former, though near or under the Equator, are resplendent with eternal snow. As shown below (p. 91) these much greater heights allow a fuller development of zones of vegetation, including a zone permanently above the cloud-level, which is wanting in southern Ethiopia.

My principal high points, previously all entomologically unexplored, were (*a*) in 1926, *Mt. Zuquāla*, about 9,900 feet, and *Mt. Chillālo*, nearly 13,200 ; (*b*) in 1948, *Mt. Damōta*, 10,400[‡], and the *Gughé Highlands*, believed to reach 13,780 feet. I had to abandon a projected journey to the *Choké* mountains in Gojjam (north-west of Addis Ababa), exceeding 13,300 feet ; while under the conditions then existing the mountains of *Simien*, 300 miles north of the capital, the highest in the country, reaching 15,156 feet[§] in Ras Dashan, could not be considered. No mountain in Abyssinia attains the line of *perpetual* snow, though the peaks of Simien are at times covered with real snow, as well as with frozen hail (see below, p. 115).

Destruction of the ancient highland fauna and flora ; former glaciation : the recent discovery of traces of extensive glaciation during the pluvial phases will no doubt modify views previously held. Nilsson (1940) has shown that in the Simien mountains approximately 440 square kilometres (nearly 170 square miles) were occupied by glaciers during the great pluvial, and even during the last pluvial as much as 60 sq. km. (about 23 sq. m.). He also found evidence of former glaciers on Mt. Chillālo ; apparently the lonely moorland saddle between Chillālo and the long range to the east (through which I was hurried in Nov. 1926, as told on p. 117) is covered with glacio-fluvial material.

Previously it had been suggested that, owing to a shifting of the prevalent winds, the mountains of Ethiopia were desiccated in the glacial periods (Hume and Craig, 1911, cited by G. E. Hutchinson, 1933, p. 463), producing cold dry conditions which might well have destroyed living organisms more than cold moist conditions would do.

[*] Messrs. R. A. Blakelock and A. D. Cotton (now working together on the tree-senecios) confirm that no Ethiopian representative of Hauman's subgenus *Dendrosenecio* is known—no truly arborescent species with a single trunk. Tall bush-senecios do occur in Ethiopia ; *Senecio gigas* (which I have not seen) is a bush 10–12 feet high, and *Senecio myriocephalus*, abundant on Mt. Tola (Gughé highlands), is a bush reaching six feet or more.

[†] These altitudes, which correspond with those on the map shown in fig. 1 (p. 96), have been widely accepted. But according to Dr. George Salt (*The Geographical Journal*, **117**, p. 150, June 1951) the highest summit of Kilimanjaro, namely Kibo, exceeds 19,500 feet. Possibly the heights of the other mountains have also been revised. Roughly corresponding heights in metres are : Kilimanjaro, over 5,900 ; Ruwenzori, 5,117 ; Kenya, 5,190 ; Elgon, 4,300.

[‡] The roughly corresponding heights in metres of my ' principal high points ' are : Zuquāla, 3,020 ; Chillālo, 4,020 ; Damōta, 3,170 ; Gughé mountains, 4,200. The altitudes of Zuquāla and Chillālo, both higher than those which I have hitherto accepted, are taken from the following sheets of the International Map : Zuquāla, G.S.G.S. 2465, 1 : 1,000,000, sheet NC. 37, 2nd edition ; Chillālo, G.S.G.S. 4355, 1 : 500,000, sheet NB. 37/2, 5th edition (see further below, p. 109).

[§] 4,620 metres (15,156 feet) is the accepted figure for Ras Dashan, though the Romegialli Expedition calculated its height as 5,050 metres (16,568 feet) ; see *Guida dell' Africa Orientale Italiana*, 1938, p. 251 (this book is later cited simply as *Guida*). Pichi-Sermolli (1940) also gives 4,620 metres as the highest altitude. I learn that Romegialli, a senior military officer, engaged in surveying but not a biologist, made no natural-history collections. As to snow on the Simien mountains, see. p. 115.

On the other hand Omer-Cooper (1930, p. 195) thought that the wide extent of the highlands would favour condensation, and therefore the complete destruction of the fauna was unlikely to have been due to drought ; but great falls of volcanic dust, accompanying the later phase (cf. p. 95) of plutonic activity, might have almost entirely exterminated at any rate the freshwater fauna. He failed to find any higher Crustacea in the lakes (principally Zwai and those adjacent) which he explored. The lack of Malacostracous Crustacea is the more striking, since one group (the Eucarida) occurs throughout Africa, including northern Ethiopia, while members of the group Peracarida are found in both North and South Africa, though apparently lacking from the rift-valley lakes and tropical Africa generally. The absence of the latter group from tropical Africa may indicate a widespread destruction of freshwater fauna through desiccation in the Pleistocene ; whilst the absence of Eucarida from central Ethiopia suggests that extermination was there even more complete owing to the added effect of volcanic dust.

From one cause or another much of the ancient highland fauna and flora seems to have vanished, not very long ago as geological periods are reckoned. The animals and plants of the middle altitudes, up to 7,000 feet or higher in some places, are recent extensions of savanna or ‘ thorn-scrub ’ fauna and flora (a statement briefly amplified below). To these considerations must be added the terrible deforestation wrought by man in Ethiopia during historic times (see pp. 92–3, 133, 148, 163). For all these reasons it is more than ever important to collect samples of the ancient fauna and flora surviving on the high mountains while they are still obtainable.

Zones of vegetation in southern Ethiopia related to those of the East African mountains : some remarks on the sequence of vegetation-zones common to all the high mountains of eastern Africa are necessary, to show how far conditions in southern Ethiopia resemble or differ from those on the mountains farther south. Dr. Jeannel, summarizing not only his personal observations but the work of many writers, has given a general account in ‘ Hautes Montagnes d’Afrique ’ (1950 *a*, chap. xiii), with diagrams of the zones on Mts. Kilimanjaro and Kenya, and on Ruwenzori ; also a diagram of Mt. Elgon in his earlier book (1934, p. 49).

The terminology used by Mr. Hedberg in his even more recent work, ‘ Vegetation Belts of the East African Mountains ’ (1951), does not entirely correspond with that of Dr. Jeannel. The latter calls the main divisions *zones*, but a zone may be subdivided into several *étages*. Mr. Hedberg (p. 163) uses the word *zone* “ to denote a more or less local ‘ altitudinal region ’, the main vegetation of which is clearly distinct from that of the adjacent zones ”. He employs the term *belt* for an ‘ altitudinal region ’ traceable ‘ on all (or most) mountains of sufficient height in a definite part of the world ’ ; such is the *montane forest belt* on the East African mountains, though the zones representing it may differ in number and appearance on each mountain. Some at least of Mr. Hedberg’s *zones* (e.g. the *bamboo zone*) correspond with the *étages* of Dr. Jeannel.

In this Report I call the major divisions *zones*, and the subdivisions, corresponding with Dr. Jeannel’s *étages*, *subzones*. But my *zones* are *belts* in Mr. Hedberg’s sense, though I do not employ the latter term.

Broadly, the East African mountains have on their lower slopes a zone of montane forest, formerly continuous over the whole land but which, with the gradual warming-up and desiccation since the glacial period, has given place to dry bush and thorn-scrub on the intervening plateaux. This *montane-forest zone*, from roughly 6,500–10,000 feet, comprises three *subzones* (*étages*), fairly clearly delimited : (i) *lower mountain-forest* (*forêt ombrophile*), largely dominated by *conifers*, especially *Podocarpus*, extending up to the altitude of maximum rainfall, about 7,800 feet ; some species of *Helichrysum* and the giant *Lobelia giberroa* occur as low as this subzone, especially in clearings ; (ii) the *bamboo subzone*, from roughly 7,800 to nearly 10,000 feet, the least mixed, an almost pure botanical formation; (iii) the *highest forest* (*étage des forêts supérieures*) dominated by *Hagenia*, from about 10,000 feet to the tree-limit at a varying altitude. (ii) and (iii) are above the limit of maximum precipitation.

Above the forest zone is the *heath zone*, in which *Erica arborea* usually predominates, extending from a little below 10,000 to about 12,500 feet. Or this zone may take the form of grassy expanses rather sparsely dotted with heaths and other plants. This zone is characterized by certain species of giant lobelia and arborescent senecio (none of the latter in Ethiopia), also of *Helichrysum*.

Still higher, above the heath zone, is the *high-mountain zone*, consisting of (i) the *Alchemilla subzone*, in which flowering-plants still maintain themselves, characterized by alchemillas, giant lobelias and arborescent senecios of particular species; beginning generally at about 12,500 feet, it extends to about 13,800 feet on Mt. Kenya, to a little over 14,400 feet on Ruwenzori, perhaps even higher on Kilimanjaro; and (ii) the *moss and lichen subzone* extending up to the altitude, varying locally, at which all vegetation ceases (Jeannel, 1950 *a*, p. 206).

The heath zone and high-mountain zone correspond respectively with the ‘ subalpine ’ and ‘ alpine ’ zones of some writers but, as stated above, the use of these terms is here avoided as misleading.

Many local deviations from this sequence occur. The limits of the zones and subzones vary on the different mountains and the several slopes of the same mountain. For instance, Mt. Meru has luxuriant rain-forest and a bamboo subzone on its southern slope, while on the north there is no bamboo and the forest is much reduced (Hedberg, 1951, p. 162). Also I learn from Mr. Schelpe (through Mr. J. Balfour-Browne) that *Protea kilimandscharica* forms open or dense scrub on the north-eastern sector of Mt. Kenya between 9,000 and 12,000 feet*, where there is little or no bamboo, the presence of the *Protea* and absence of bamboo being probably due to the low rainfall (about 25 inches a year) in this part of the mountain; certain of the giant lobelias grow there, within the same altitudes but, requiring far moister soil, they are confined to small areas of swampy ground. These divergences are related to the rainfall, to the latitude and situation of each mountain, to the climate of surrounding lands, as well as to minor local conditions.

In relation to the general sequence of zones the high altitudes of Ethiopia have certain peculiarities. The average height of much of the plateau is exceptionally great, but the heights of the isolated massifs rising above it are less than those of the highest East African mountains. Consequently coniferous forests exist in some places comparatively little above the general plateau-level. Such are Jem-Jem Forest, west of Addis Ababa, at 8,000 to 9,000 feet, composed mainly of *Juniperus procera* and *Podocarpus*; also the noble Magādo Forest in southern Sidāmo, consisting (as far as I could see on my hurried passage through it) of almost unmixed *Podocarpus* of enormous size. Some of these coniferous forests are not surmounted by any subzone of bamboo or zone of heaths, as the nearby country rises no higher. As to the Amharic names of these two important trees: the giant juniper (sometimes wrongly called ‘ cedar ’) is *tid*, with an ‘ explosive ’ *t*; the *Podocarpus* is *zigba*, while in French this tree is called *bois blanc*.

Deforestation in Ethiopia has been carried to such lengths that large parts of the highlands are entirely denuded of forest. But though this denudation is rightly stressed (Jeannel, 1050 *a*, chap. x), I doubt if it is realized how large are the coniferous and other high-altitude forests still existing, especially in southern Sidāmo and the southern part of the Gughé Highlands.

In Sidāmo deforestation is creeping south, as the forests give way to plantations of coffee and *enseté*. Unless forest-conservation be enforced, Sidāmo on the east of the lakes will become as denuded as Gāmo on the west.

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* The Proteas which I saw on Mt. Damōta (determined as *Protea abyssinica*) and those seen but not flowering on the range south of the Gughé mountains were only at about 7,000 to 8,000 feet.

(All statements in this Report on forests and deforestation in Ethiopia were in print before I saw Logan's important work (1946). But although the several forests with which I deal are not classed exactly according to his "Types of Woodland", my remarks do not conflict with his paper.)

The following concise statements show to what extent the several mountains and massifs fit into the sequence of zones :—

Mt. Zuquāla (1926) : I recall no *Podocarpus*, but the conifer-forest is represented by a small wood of junipers (*Juniperus procera*), with *Lobelia giberroa* in clearings, on the inner side of the highest part of the crater (nearly 10,000 feet), to the east ; the bamboo subzone seems to be represented only by some patches on the outer margin of this highest point ; but the heath zone is well represented, the rest of the crater-rim and its inner walls being covered with *Erica arborea* and *Hypericum*, which form very tall bushes or small trees in the shelter of the crater. *Helichrysum abyssinicum*, *Kniphofia* and other characteristic plants are components of the heath-association.

Mt. Chillālo (1926) : the west side presented a large expanse of grass with coarse tussocks between 8,000 and 9,000 feet. Above this a belt of mixed forest, with some rather small juniper and *Podocarpus*, extends from about 9,000 to 10,000 feet, with gnarled old *kosso*-trees (*Hagenia*) as its upper limit. These last represent the highest subzone of forest, and there is not (as far as I saw) a definite bamboo subzone between the lower and highest forest subzones. On the southern slopes, overlooking the plateau of Albasso, broad expanses of short turf thickly dotted with the giant *Echinops ellenbeckii*, eight to ten feet high, displaying great globular heads of little crimson flowers, constitute a special local feature. Above the forest zone as a whole is the heath zone, with *Erica arborea* fairly dense up to the top, yet becoming more and more stunted in this exposed situation. On the top, expanses covered by *Alchemilla haumannii** and clumps of *Lobelia rhynchopetalum* represent the high-mountain zone. Other plants found in these highest zones are mentioned below, in comparing this mountain with Mt. Tola (p. 151).

Mt. Damōta (1948) : close cultivation has greatly modified the natural plant-associations. On the part of the massif visited, namely the southern slopes, the only mixed forest remaining contained apparently no conifers, but was of a nature suited to the altitude (probably not exceeding 7,000 feet) ; it even included a few wild palms (*Phoenix*). But the bamboo subzone, though not continuous, is well represented by separate woods and groves neatly delimited by man. The highest forest is represented by the *Hagenia*-trees at the top, though many are artificially planted round fields. Relics of the heath and high-mountain zones remain on parts of the higher slopes, for instance on the partly detached southern spur (p. 133), where the herbaceous *Alchemilla fischeri* was found. But the rounded grassy summits are bare of all trees and bushes.

The Gughé Highlands (1948) : in the northern part, especially the Bonghé valley, deforestation and intensive cultivation render the limits of the several zones and subzones even more difficult to recognize. Some plants originally associated with the subzone of lower mountain forest stand as relics among the cultivated fields ; for instance *Lobelia giberroa*, planted or at least preserved near houses (p. 148), while small patches of wild bush remaining in the Bonghé valley include, *inter alia*, euphorbias (*E. obovalifolia*) and a species of *Gymnosporia*, a tall bush, the Galla name of which my cook translated 'dogwood'. The only other remnants of this subzone are a few small patches of forest on the steep slopes (seen right of centre, Pl. 16), probably venerated for some reason and therefore left isolated among the fields. The bamboo subzone, as on Mt. Damōta, has been divided by clearing into separate woods, some of which are very large, though neatly confined to the least accessible places. The subzone of highest forest is represented only by small groups of *kosso*-trees (*Hagenia*) and very tall bushes or small trees of *Hypericum* and *Erica arborea*, the last indicating a transition to the heath zone. In places these trees have been left standing between fields when the rest of the forest was cleared. Up the steep higher slopes above the forests extends the heath zone, the plants of which mingle on the mountain-tops with those of the high-mountain zone. These are described below (pp. 149–51), where local differences between Mt. Tola and Mt. Gughé (proper) are considered, and both are contrasted with Mt. Chillālo. Description of the much less deforested southern parts of the Gughé mountains, and the luxuriant forests where tropical elements mix with the lowest part of the montane forest, is also attempted in the narrative (pp. 154–5).

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* *Alchemilla haumannii*, which I discovered on Mt. Chillālo in November 1926, was described as *A. chillaloensis* by Professor Hauman and Mlle. Balle ; but specimens had also been submitted to Rothmaler, whose description under the name *A. haumannii* appeared first.

High mountains in western tropical Africa: in order to keep this Report within reasonable compass, I have to limit this section to relating the zones of vegetation on the high mountains of southern Ethiopia with those on the high East African mountains. But it may be noted that studies of the same kind regarding high mountains in West Africa have been published, and others will probably appear. For example, a very suggestive study, with insistence on the need to save forests and the flora of 'pseudo-alpine' grass-land from destruction, is that of H. Jacques-Félix (1945) on the Bambuto massif, in French territory north-east of Mt. Cameroon. Though the Bambutos attain only 2,680 metres (about 8,790 feet) as compared with the 4,070 metres (13,350 feet) of Mt. Cameroon itself, they are botanically of great interest. Broadly viewed, some of the phenomena are the same as those on the East African mountains, for instance the mingling of forms of northern (mediterranean) and South African origin. But a detailed analysis shows very considerable differences between the vegetation of these and the East African mountains. Swift collaboration between the French and British authorities is needed if these West African mountain-floras are to be saved. Mt. Cameroon itself and other mountains in West Africa, as well as the islands in the Gulf of Guinea, have been and still are the subject of research on similar lines.

A comparison between the insects associated with high-mountain plants in eastern and western Africa lies far more in my own province. That some steps to compare them have been taken is shown below; see p. 103.

Quolla, Waina Daga and Daga: the Ethiopians themselves distinguish several zones of altitude, mainly by their agricultural products. The lowest, *quolla*, stretches from sea-level to between 1,500 and 1,800 metres (approximately 4,900–5,900 feet). Next, *waina daga*, from the upper limit of the *quolla* to between 2,400 and 2,500 metres (7,800–8,200 feet). Still higher, simply *daga**, up to 3,500 metres (11,400 feet). These figures are taken from the *Guida* (p. 55), in which a fourth zone (*urèc* in Italian transliteration, possibly identical with *arakh*, a mountain-side), cold and rainy, above 11,400 feet, is recognized, but I have not met with this term elsewhere.

Other writers divide the altitudes more simply; to Azaïs and Chambard (pp. 205,270), all is *quolla* below, and *daga* above, 2,000 metres (*c*. 6,500 feet). Though on paper these delimitations may appear academic, in practice the traveller soon recognizes the broad distinctions between the types of country, though the limits of the zones vary locally in altitude and sharpness.

Having done no serious collecting below 5,000 feet, I only know the upper part of the *quolla* and the zones above. *Waina daga* ends at the upper limit of acacias. The difference between its vegetation and that of the *daga* is exemplified by the conspicuous tree-euphorbias, *E. candelabrum* below and *E. obovalifolia* above the limit between these two zones (see p. 126). The *montane forest*,

* The first vowel in *daga* has a neutral sound.

heath and *high-mountain zones*, those specially under review in this Report, are all parts of the *daga*.

To the excellent Eritrean hospital-dresser accompanying my party the difference lay between the *bassopiano*, where paludrine must be issued daily to each man, and the *altopiano*, where malaria need not be feared. (NOTE : I cannot enter here into the distribution of *mosquitos and malaria* in Ethiopia, but would refer to Scott, 1927 *b* ; Edwards, 1928 ; Bevan, 1937 ; Giaquinto-Mira, 1950).

The Galla Depression ; relation of the high mountains of southern Ethiopia and eastern Africa to the Rift-Valley system : the peculiar interest of the region lies in the fact that all the mountain-massifs under review are related to this immense system of fractures—a system extending over more than a quarter of a meridian of longitude, from the Jordan Valley to a point south of the Zambesi (fig. 1, adapted from Gregory, 1921, p. 358). The particular member of this System with which the high mountains of southern Ethiopia are associated is the trough or depression slanting diagonally across Ethiopia from north-east to south-west, from the point where the troughs of the Red Sea and Gulf of Aden meet to the northern end of the East African Rift at Lake Rudolf. This Ethiopian trough, containing the chain of Galla lakes, is here termed ' the *Galla Depression* '.

At its north-eastern end the limits of the Galla Depression are determined by two series of fractures. One, directed from north to south, forms the eastern escarpment of the high plateau of northern Ethiopia ; the other series, east-north-east to west-south-west, forms the Harar and North Somaliland escarpment. From the point of convergence of these two series, the fractures lie parallel. The Depression between them encloses the furrow in which the Hawash River descends from the highlands to end in the lakes of Aussa (Thesiger, 1935) in the Danakil desert. South of the Hawash this trough is continued as a series of hollows holding the chain of the Galla lakes, from Lake Zwai to Lakes Abaya and Chamo, and the impermanent Lake Stefanie (Zavattari, 1942), whence it continues to the northern end of Lake Rudolf, there to unite with the meridionally directed East African Rift.

Associated with the Galla Depression are many volcanic formations of the second or ' Aden ' series, formed mainly of Pliocene and Pleistocene basalts and trachytes, as distinct from the much earlier ' Trap ' series, consisting of dolerites and basalts dating probably from early Tertiary or even Cretaceous times, and forming the great table-lands of northern and western Ethiopia (Stefanini, 1932).

Though there are now no active volcanoes in central Ethiopia, yet those of the later series are in some cases scarcely quiescent. This applies specially to the eastern confines of the country ; e.g. the volcano Dubbi, a little south of Edd on the Danakil coast, erupted in 1861, and Dofan, in the lower Hawash valley, has active fumaroles (*Guida*, p. 45). The apparently extinct volcanoes of this series include Fantallé, Ayelu* and others in the middle Hawash valley and Mt. Zuquāla higher up, i.e. farther west. The many hot springs include those supplying the thermal establishment in the lower part of Addis Ababa, others near the north end of Lake Abaya, and one (described below, p. 165) near Dilla, east of that lake ; also those on the islet of Thābal in the bed of Lake Stefanie (Zavattari, 1942, p. 336).

To the north-east, the Ethiopian series of volcanic structures is continued in the *harras* and other volcanic formations of the foothills and highlands of South-West Arabia. To the south, the Ethiopian series unites with that of the Rift Valley, in which Teleki's volcano, at the southern end of Lake Rudolf,

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* Fantallé is west of the Hawash, near Metahara station on the railway from Djibouti to Addis Ababa ; Ayelu is east of the Hawash, nearly 50 miles north of the railway. Both are about 6,000 feet high. The railway to Addis Ababa follows the gradual rise of the Depression, avoiding the steep escarpments on either side.

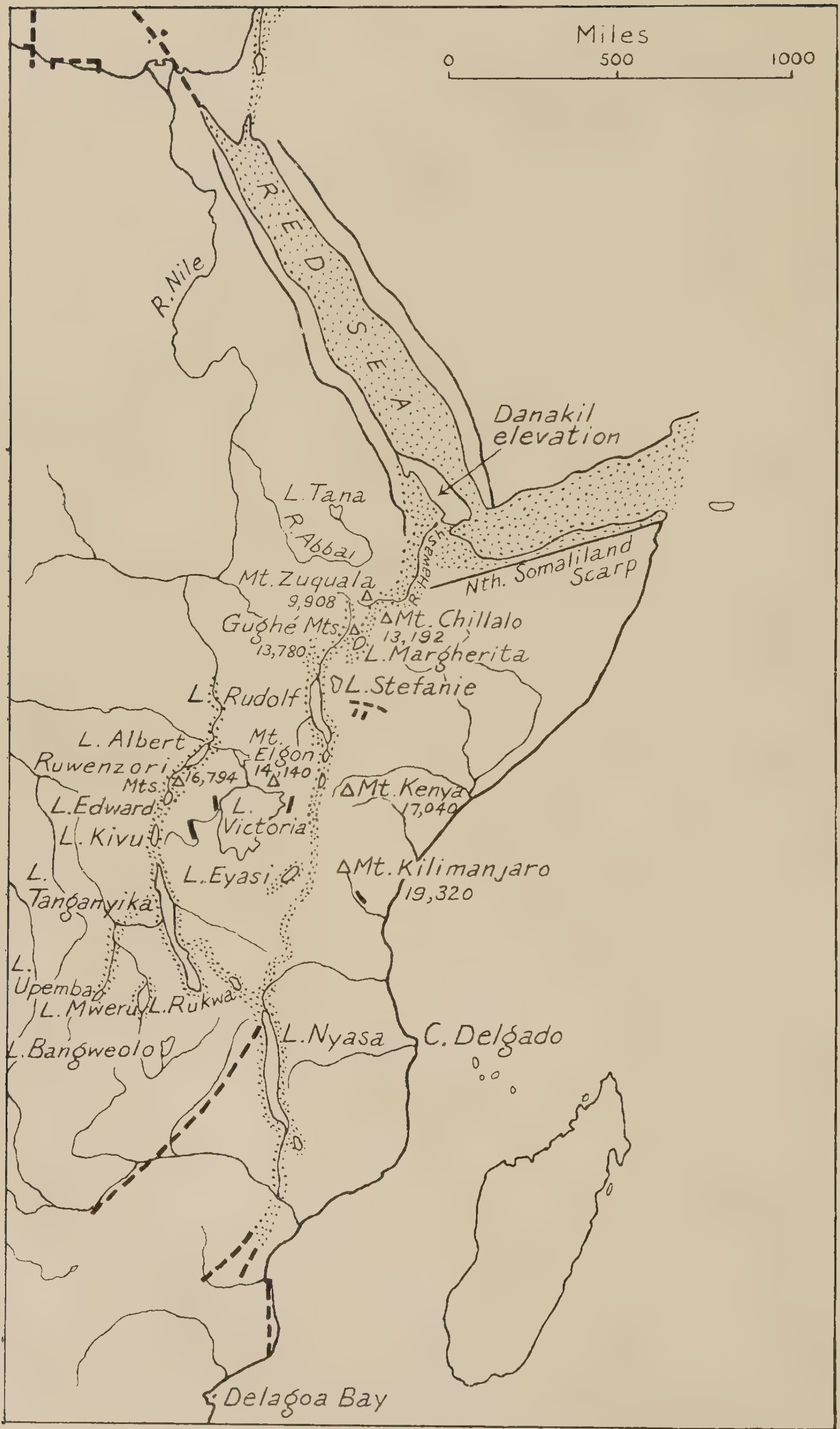

Fig. 1.—Relation of the high mountains of southern Ethiopia and eastern Africa to the Rift-Valley System (adapted from J. W. Gregory, 1921).

has been active in our own time (Champion, 1935 and Fuchs, 1935), and part of Kilimanjaro is even now in an active ' solfatara ' stage*.

South of Ethiopia the Rift-Valley System consists of two principal components ; the eastern, or ' Rift Valley ' proper, extends north to south across Kenya Colony and Tanganyika Territory, containing Lake Rudolf and some smaller lakes (Baringo, Naivasha) ; in the western, or ' Tanganyika Trough ', lie Lakes Albert, Edward, Kivu and Tanganyika. The united eastern and western troughs continue southward as a single fosse with Lake Nyasa in its northern part. Almost all the larger lakes of eastern Africa lie in parts of the Rift-System, the chief exceptions being Lake Victoria, midway between the western and eastern rifts, and Lake Tana in northern Ethiopia.

Whatever the origin of these fractures, vast escarpments were formed along the lines of faulting, while chains of mountains were elevated near the edges of the troughs, or in some cases in the floor of the latter (e.g. the Mfumbiro or Birunga volcanoes, between Lakes Edward and Kivu ; and the barrier across the eastern Rift south of Lake Rudolf, including Teleki's volcano, mentioned above).

The Ruwenzori chain, in the western series of mountains, is an exception to their generally volcanic nature. Its extremely ancient structure has been elucidated mainly by the geologists of the Italian (Abruzzi) Expedition of 1906, and of the Belgian Expedition in 1932, whose work is summarized by Jeannel (1950 *a*, pp. 167–70, and de Grunne, 1937). Otherwise the western series includes the above-mentioned Birunga (Virunga) volcanoes, some at least of which are still active, e.g. Karissimbi (14,700 feet) and Nyamuragira (a little over 10,000 feet)†.

The mountains of the eastern series concern us more nearly, since they include all the mountains of central and southern Ethiopia now under review. The extinct cone of Zuquāla and the massif of Chillālo stand on opposite sides of the Galla Depression, on the western edge of which, farther south, rise the isolated massif of Mt. Damōta and the great block of the Gughé Highlands. Southward again, Mt. Kenya and the Aberdare range (including Mt. Kinangop, *c.* 12,800 feet) on the east side of the Rift Valley ; Mt. Elgon and Cherangani (the latter *c.* 11,300 feet) on the west side ; and Mt. Kilimanjaro with the associated Mt. Meru (*c.* 14,600 feet) to the south-west and the Chyulu Hills to the north-east, are all related to the great eastern trough, the Rift Valley proper.

Are certain peculiarities of the high-mountain insect-fauna related to the geological structure of the region ? Instances drawn from several classes of phenomena indicate that this is so.

As stated above (p. 88) the species restricted to the highest altitudes appear to consist partly of descendants of ancestral forms wide-spread in former periods of cooler and moister climate.

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* A striking aerial photograph of the Kibo summit of Mt. Kilimanjaro (in a letter from Mr. P. C. Spink, *Country Life*, 11 August 1950, p. 458) shows a small inner crater or ash-cone inside the outer crater (or caldera) ; the ash-cone is almost encircled with solfataras, emitting gases at temperatures up to 172° F. Mr. Spink refers to his writings on the continued activity of Kilimanjaro in the *Geographical Journal* and elsewhere for some five years past. (Mention should also be made of Dr. George Salt's article ' The Shira plateau of Kilimanjaro ' in the same journal, cxvii, part 2, June 1951, pp. 150–66.)

† See a remarkable photograph, taken at night in April 1938, of Nyamuragira in action, *Premier Rapport* (1934–40), *Fondation pour favoriser l'étude scientifique des Parcs Nationaux du Congo Belge*, p. 31 ; showing the several active mouths of the ' adventitious ' crater of Tshambene, and forest set on fire by the lava. Fine photographs of this and other of the Kivu volcanoes (though not in action) are given in *Premier Rapport quinquennal* (1935–39), *Institut des Parcs Nationaux du Congo Belge*. See also chaps. ii–iv of Dr. Jeannel's book (1950 *a*) and, for general structure of the region, many illustrations in Bailey Willis, ' Studies in comparative seismology : East African Plateaus and Rift Valleys ' (*Carnegie Institute*, Washington, 1936, no. 470).

Some of these, for instance, the subfamily Trechinae and the tribe Anillini of the Carabid beetles, constitute evident links between the Palaearctic fauna and that of the East African mountains. Moreover the Trechinae point to these mountains having been populated by ancestral forms from both north and south, the descendants of which, though interlocking in eastern equatorial Africa, do not (as far as known) mingle on the same massifs. These cases are discussed under (*a*) below (p. 100).

A second class of phenomena (illustrated below under (*b*), pp. 102–3) is that of species evolved by isolation on separate massifs, and closely associated with high-mountain plants. The inference is that these insects are ' relicts ' of an ancient Tertiary fauna, for the association appears to have lasted a very long time, as insects and plants have apparently become specialized together.

What may be a third class of phenomena, exemplified (p. 104) under (*c*), is that of high-mountain species believed to have been directly evolved during comparatively recent, i.e. post-glacial, time, from parent-species inhabiting the surrounding plateaux. If this be so, there is no question of these species being ' relicts '.

No attempt is made to date precisely the origin of the high-mountain species : apart from the allusion below (p. 100) to continental drift, a controversial subject, I confine myself to the known facts of distribution of certain groups of mountain insects. Though aware of the advances taking place in ' geochronology ', I prefer not to define the periods of immigration of ancestral forms, or the chronology of the evolution of species now living—or not further than broadly distinguishing between ' relicts ', presumably descended from ancient pre-glacial stocks and specialized through isolation, and those believed to have originated directly from parental stocks in the surrounding plateaux during post-glacial time. These points in geological time can only be inferred from the distribution of existing species ; for, though many fossil insects are known, few (except very recent remains) can be identified as members or near relatives of existing genera. No fossil elucidating the distribution and evolution of high-mountain insects in East Africa has yet been found. (What a contrast is presented by the giant mammals ! In the extensive late Tertiary and Quaternary deposits near the lower course of the Omo, the species have been identified, some as extinct, others as still living though no longer inhabiting the district ; see Dr. Jeannel's popular account, 1934.)

Nor do I here try to correlate the distribution of these high-mountain terrestrial insects with that of the aquatic animals of the East and central African lakes. Such an attempt at correlation might well prove interesting, for the lakes include remarkable relicts of an ancient African fauna. The river-systems also have been greatly altered, in some cases reversed, by geological and climatic changes*.

(*a*) *Some insects restricted to the high mountains of Ethiopia link the Palaearctic fauna with that of the East African mountains* : this is well shown by two sections of the immense Coleopterous family Carabidae, (i) the sub-family Trechinae† already mentioned (p. 98), and (ii) the tribe Anillini of the sub-family Bembidiinae.

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* For instance, Lake Rudolf is believed with good reason to have formerly overflowed into the Nile system (see E. B. Worthington in Fuchs, 1935, p. 141, and elsewhere).

† Trechinae are here treated as a sub-family of Carabidae, in the sense of Jeannel's 'Monographie des Trechinae' (*L'Abeille*, xxxii, xxxiii and xxxv, 1926–8), though he has more recently (' Nouveau Traité de Zoologie ', ix, pp. 1,044 sqq., 1949) revived the separate family Trechidae (Bonelli, 1810), including in it the Trechinae and three other sub-families. The numerous swift-running species vary in length from under three to about eight millimetres. They include several British species rather local in distribution. The twenty or more inhabiting north-central Europe, mainly found in alpine pastures, at the borders of the snow, or in woodlands beneath dead leaves and moss, include several flightless forms, with hind wings partly or entirely atrophied (see E. Reitter, 'Fauna Germanica', Käfer i, pp. 126 sqq. 1908). Members of this sub-family inhabit higher altitudes and higher latitudes than, probably, any other beetles, including a species occurring at 18,000 feet in Tibet and representatives in Iceland and the islands of Cape Horn.

(i) The Trechinae known from the western series of high mountains are species of *Plocamotrechus*, a genus placed with others in the tribe Trechodini, believed to be of southern origin.

On the other hand all the Trechinae known from Ethiopia belong to the genus *Trechus*, type-genus of the overwhelmingly Palaearctic tribe Trechini. Of eight species hitherto discovered in Ethiopia, two were found nearly 70 years ago by the late Achille Raffray on Mt. Abuna Yosef, about 220 miles north of Addis Ababa, in damp clay soil above 13,000 feet*. A third was collected in 1904–5 by Baron Maurice de Rothschild on the banks of the Little Akaki River near Addis Ababa, at about 7,200 feet. In November 1926 I collected four species, all new, on Mt. Chillālo at 13,000 feet, under stones, at roots of plants, or in damp moss (Jeannel, 1936); and in December 1948 I discovered one more (Jeannel, 1950 *b*) in the Gughé Highlands, in damp humus under the bamboo woods and among roots of ferns and other plants, at altitudes between 10,600 and at least 12,000 feet (thus I have more than doubled the small number known from Ethiopia).

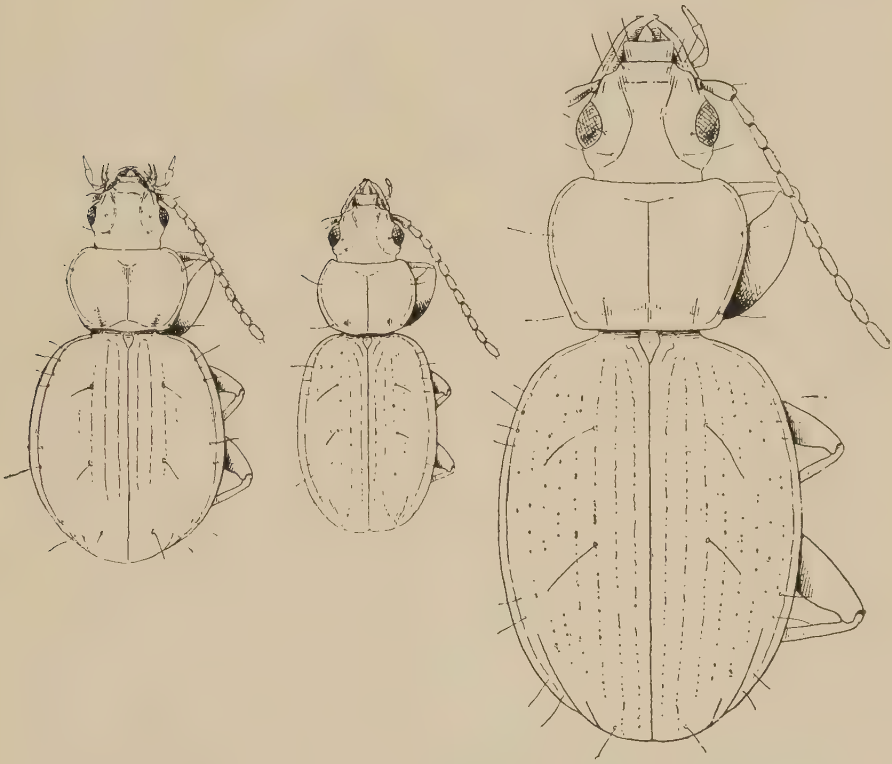

FIG. 2.—Montane species of *Trechus*. Left to right, *T. gugheensis* (Gughé Highlands); *T. culminicola* and *T. chillalicus* (both from Mt. Chillālo); all ×15 (from Jeannel, 1936, 1950 *b*).

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* *Trechus bipartitus* and *T. sublaevis*, both described by Raffray, *Ann. Soc. ent. France*, Dec. 1885, p. 318.

The seven species from the high mountains are all, so far as known, confined to particular massifs. The species from the more moderate altitude of 7,200 feet is closely related to, even if not identical with, one known from Mt. Meru*. In either case the species inhabiting Ethiopia form a southern extension of this Palaearctic genus, linking its northern representatives with the numerous species restricted to Mt. Elgon, and with the one inhabiting Mt. Meru. Indeed, the links in this chain are graduated, the species found on Chillālo being more closely related to those inhabiting the northern Mt. Abuna Yosef, while the one recently discovered on the Gughé mountains is nearly related to an Elgon species. Mt. Elgon † recalls the lengths to which speciation has gone in certain remote islands; more than twenty distinct species and subspecies were discovered on only one-tenth of the 10-mile circumference of its crater (Jeannel, 1935, especially pp. 23–9).

Dr. Jeannel may well be right in suggesting that the chain of mountains lying west of Lake Rudolf, and extending between the south-western highlands of Ethiopia and Mt. Elgon, served as a migration-route southwards to the mountains associated with the eastern trough of the Rift system. The southernmost of the mountains west of Rudolf, Mts. Debasien and Moroto, exceed 10,000 feet, and, though now partly arid‡, the whole chain must have enjoyed a moist climate and been largely forest-covered in the early Tertiary (see Lönnberg, esp. p. 32).

Although species of *Trechus* inhabit Mt. Elgon and Mt. Meru, none seemingly has succeeded in colonizing Ruwenzori or other mountains of the western series, separated from the eastern series by the lower tracts of Uganda and the Sudan. It is less easy to account for the apparent absence of *Trechus* from Mt. Kilimanjaro, Mt. Kenya and the Aberdare range, on all of which the southern genus *Plocamotrechus* is represented.

Not only are Trechinae of northern affinities apparently absent from the western mountains, but on Ruwenzori even those of southern origin (*Plocamotrechus*) hitherto discovered are few—an instance of the poorness of the fauna in several groups of insects, ascribed to the excessive humidity of the soil. There is no sign that Ruwenzori harbours a wealth of Trechinae comparable with that on Mt. Elgon. The four *Plocamotrechus* collected on Ruwenzori between 9,800 and 14,000 feet are represented by distinct local races in different parts of the massif, as though species-formation may be still in progress (Jeannel, 1940).

To recapitulate: Trechinae of northern and southern affinities interdigitate in eastern equatorial Africa, but apparently do not mingle on the same massifs. Descendants of species inhabiting the region during the early Tertiary presumably took refuge on the high mountains during the drier late Tertiary (Pliocene). Isolated on the separate massifs, they have survived the alternating wet and dry periods of the Pleistocene (Quaternary), and the increasing dryness of post-pluvial time. Localized new forms have evolved, as on 'islands' separated by wide stretches of tropical plateaux.

As to a theoretical explanation of these phenomena: assuming momentarily the theory of continental drift, the southern ancestral stocks of African Trechinae are believed to have arisen in early Tertiary time in the primitive land-mass of southern Africa, where existing descendant species

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* The species from 7,200 feet near Addis Ababa is *Trechus aethiopicus* Alluaud (1918), and the closely related or identical form from Mt. Meru is *T. sjöstedti* Alluaud (1926) see Jeannel, *L'Abeille*, xxxv, p. 791, 1928.

† Mt. Elgon is also the point where the largest number of wingless genera and species of minute flies of the family Sphaeroceridae (Borboridae) has been found. Brachypterous and apterous members of this family occur in many parts of the world, but are particularly developed on the mountains of eastern and central Africa, while I have discovered two in Ethiopia. Their origins appear to be polyphyletic, and study of them has necessitated the erection of several genera, some monotypic (see Dr. O. W. Richards, 1951).

‡ I am told that the mountains west of Lake Rudolf are not as entirely arid as is implied in certain writings. Some of these mountains bear considerable expanses of forest.

(of *Plocamotrechus* and allied genera) have a wide and continuous distribution at low or moderate altitudes (including one representative, the flightless *Amblystogenium pacificum*, in the remote subantarctic Crozet Islands); but other descendant species, the ancestors of which spread northwards to the East African mountains, have been restricted by subsequent climatic changes to the higher parts of isolated massifs. On the other hand, the northern ancestral stocks arose on the primitive land-mass of Angara (the part of Asia north of Lake Baikal, between the Lena and Yenisei rivers), and their descendants, spreading southwards and likewise isolated by later climatic changes, have given rise to many forms also confined to single massifs, but not to the same mountains as those harbouring the species of southern origin*.

(ii) The Bembidiine Carabidae of the tribe Anillini are among the smallest beetles (1–2 mm. long), flightless, with eyes entirely atrophied or at any rate greatly reduced. From lack of pigment the body looks pale yellowish. Subterranean, they live under deeply sunk boulders or in fissures of damp soil (mainly argillaceous, but also calcareous and volcanic). In dry weather they penetrate deeper, but move nearer to the surface after rain. In Mediterranean countries they favour the more uniformly moist northward slopes. Probably they are carnivorous (as is normal in Carabidae), but their early stages are unknown. Being endogaeous, they have the antennae, palpi and legs short, adapted to life in confined spaces in the soil, as opposed to insects dwelling in the ample spaces of caverns, which frequently have these appendages long, strangely formed, and modified to serve as tactile organs in the darkness.

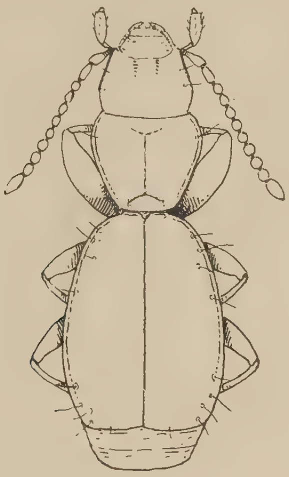

FIG. 3.—*Cryptorites scotti*, a minute depigmented form with only slight vestiges of eyes, living in the soil; ×55 (from Jeannel, 1950 *b*).

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* According to Dr. Jeannel's exposition (1942, pp. 317 sqq.) the parental stocks of *Plocamotrechus* were differentiated at the beginning of the Tertiary on the vast mountainous land-mass of southern Africa, already folded at the end of the Primary, and broken by the fractures dividing the ancient hypothetical Gondwanaland when the Atlantic Ocean and other seas originated as rifts. The Crozet and other subantarctic islands are held to be remnants of Gondwana. The flightless *Amblystogenium*, now confined to the Crozet Archipelago, and the parental stocks of the closely related South African *Plocamotrechus*, were differentiated presumably not earlier than the Miocene, previous to which the climatic conditions would have rendered it imossible for Carabid beetles to live in the Crozet islands. The great fractures of the Rift-Valley System are also believed to have first opened in Miocene time; while the separation of the descendant species of *Plocamotrechus* and *Trechus* on different East African massifs depended on the formation of that system of rifts.

The methods by which I discovered two representatives of this tribe living together in humus at 10,000 feet are told below (p. 152). These, the first Anillini ever recorded from Ethiopia, are evident links with the East African mountain-fauna. One is a new species of an entirely blind genus (*Microdipnus*) hitherto known only from Mt. Kenya. The other, also new, with vestiges of eyes, constitutes a monotypic genus (*Cryptorites*) related to *Microdipnus*, but having exceptional features (Jeannel, 1950 *b*, pp. 179–83).

Regarding further biogeographical implications, I would refer to Dr. Jeannel's monograph (1937, especially pp. 242–3 and 353 sqq.; also to his book, 1942, pp. 274–7, 387–91). The genera and species of Anillini are on the whole far wider-ranging than the localized cavernicolous species of related groups (e.g. Trechini). A strong case for hypothetical conclusions can be based on their structure and distribution. Certain archaic structural features may point to Anillini having originated in the Secondary (Mesozoic) Era, perhaps early. As to distribution, despite intensive search, no Anillini have been found in the colder parts of the world, such as northern Europe (none is known from the British Isles though a species of *Anillus* has been discovered in Belgium). But the occurrence of many representatives in Mediterranean lands can be related to the concept of an ancient land-mass of Tyrrhenis; while the existence of many others in countries round the Indian Ocean, with outlying species in Australia, New Zealand and South Africa, bears on the concept of a former continent of Gondwana.

I have discussed Trechinae and Anillini at length, but it must be remembered how intensely the light of taxonomic and biogeographical research has been focused on these groups. The studies of other sections of Carabidae by M. Basilewsky and Dr. Straneo, to appear shortly in the Linnean Society's *Journal*, will provide further biogeographical data.

(Apart from links between the Palaearctic and East African faunas, other remarkable instances are known among insects from Ethiopia of adaptation to a subterranean existence, accompanied by atrophy of eyes and wings, and usually by reduction of pigment. My discovery, under boulders at Chencha, of a much larger blind Carabid, belonging to a different subfamily, is mentioned on p. 141. In the Curculionidae (weevils), a family very widely removed from Carabidae, the same characteristics are shown by a new species of *Pentarthrophasis* (to be described by Sir Guy Marshall), discovered under boulders at Addis Ababa by the Marchese Saverio Patrizi in 1941, and rediscovered there by Dr. Giaquinto and myself in 1948. Moreover, besides Coleoptera, Patrizi discovered at Addis Ababa a totally blind Blattid, with elytra much shortened and no hind wings; *Nocticola bolivari*, the biogeographical relationships of which are indeed interesting, if it be truly endemic, as is believed (L. Chopard, 1950). The occurrence of Diptera which, though not blind, are wingless, is mentioned on p. 100, footnote.)

(*b*) Leaving aside the question of biogeographical links with other regions, the following instances are chosen to illustrate primarily the *effect of isolation on separate massifs on the evolution of congeneric but distinct species; also the close association of these insects with certain high-mountain plants, indicating parallel evolution of insects and plants and (in some cases) assumption of 'giant' stature in both*:—

(i) *Species associated with giant lobelias and arborescent senecios*: having discovered, on the summit of Chillālo in 1926, six species of Coleoptera (four Staphylinidae, two Cryptophagidae) under the bark of dead stems of *Lobelia rhynchopetalum*, and a species of Scolytidae in a fetid dying inflorescence of *Lobelia giberroa* on Zuquāla, I suspected the existence of a larger assemblage of forms associated with giant lobelias. I had not long to wait. So rich a material was soon available from collectors on the East African mountains, that I listed (1935, 1940) 49 species, representing 13 families of beetles, taken from these plants and from arborescent senecios. Fourteen species were new to science. Four widely distributed species were evidently casual visitors to the plants, but the remaining 45 were, with one exception, known only from one massif; and, since half of these latter are flightless (having the hind wings either vestigial or entirely atrophied), they have little power of spreading. Moreover, the list of species haunting giant lobelias and senecios, also 'everlastings' (*Helichrysum* spp.), is far from complete. The copious material obtained by the British Museum Ruwenzori Expedition (1934–5) still awaits study. The Coleoptera of several families collected in 1948 from both the species of giant lobelia occurring in Abyssinia (among them adults and larvae of a Cossonine weevil boring in the woody stem of *Lobelia giberroa*) may also include new species restricted to the Gughé mountains.

(ii) *Parallel evolution of 'giant' plants and associated insects*: in the same papers (1935, 1940) I noted the exceptional size of some of the insects associated with giant lobelias and senecios. Certain Cryptophagid beetles, both winged and wingless species, from three to four millimetres long, though not 'giants' by ordinary standards, are gigantic compared with other species of the same genera. I put forward the idea that the association between plant and insect may be extremely ancient, and that the same factors, adaptation to very high altitude and severe climate, combined with isolation, may have induced parallel evolution with the same trend in both plants and insects.

The two foregoing paragraphs should be qualified by the statement that I do not believe each species of these beetles to be *exclusively* associated with a single species of plant. I agree with Dr. Nils Bruce* that the beetles cannot be safely identified from their oecological environment alone. It seems, however, probable that groups of specialized beetles and plants have evolved within their respective genera. Moreover those species of beetles which are not only confined to one massif but are also flightless may be almost exclusively attached to a single species of giant lobelia or senecio, if only one such plant-species occur on the mountain. On the South Ethiopian mountains I have searched for hours among many kinds of plants, yet found the Cryptophagid beetles only on giant lobelias, among the flowers, or under loose bark when the plant is not flowering. Yet in *Pseudomesites*, a genus of weevils normally associated with giant lobelias and senecios, I collected three specimens of a new species (*teste* Sir Guy Marshall) on Mt. Gughé itself; two were taken from *Lobelia rhynchopetalum*, while the occurrence of the third among dead leaves of *Kniphofia* shows that such insects occasionally wander from their normal plants.

(iii) *an analogy in West Africa; primary and secondary biocoenoses*: giant lobelias and arborescent senecios occur at least 1,500 miles west of Ruwenzori, on the mountains of the Cameroons and on Fernando Poo. An interesting little assemblage of Coleoptera is associated with a giant Lobelia (*L. columnaris*) at altitudes between 7,500 and 8,200 feet in the mountains of Bambuto or Bamenda (north-east of Mt. Cameroon). There this plant, which reaches six feet high, grows among high-mountain prairies, probably formerly forested. The beetles comprised nine species (seven new), representing seven families, but taxonomically this lobelicolous association is very different from that existing in eastern Africa. In both cases, however, some of the species are not exclusively attached to the plants.

The discoverers (Paulian et Villiers, 1940) distinguish between primary and secondary biocoenoses. The Coleoptera attached to succulent Euphorbias in Marocco, the Senegal and the Atlantic islands illustrate the former; they consist of members of a few genera, for the most part strictly attached (*inféodés*) to the plants, so that in each case the insect can extend its range with that of the host-plant. But the lobelicolous beetles are regarded as a secondary biocoenosis or residual fauna, comprising species which have, in the West African case, survived the disappearance of the forest in the special environment (*habitat privilégié*) provided by the giant Lobelia. In eastern Africa they may even have secondarily extended their original range through attachment to these plants. Thus there is no reason why such faunistic associations should include the same taxonomic elements in different regions—as in fact, in this case at any rate, they do not.

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* N. Bruce, *Exploration du Parc National Albert, Mission G. F. de Witte* 1933–5, fascic. 75 (Cryptophagidae), 1951.

[*Note on Coleoptera found in the flowers of Protea-trees*: I got no insects from these trees, only one of which I saw in flower in Ethiopia. But Mr. J. Balfour-Browne is studying the beetles collected from *Protea*-blossoms by Mr. John Riley on Mt. Kenya (Oxford University Expedition, 1949). Judging by what Mr. Balfour-Browne has shown me, another association of particular beetles and flowers is coming to light, including beetles belonging to a family not represented among those hitherto found on giant lobelias or senecios. Considering the remarkable geographical distribution of the genus *Protea* and of the family Proteaceae as a whole—the latter apparently radiating northwards in many lands from a southern dispersal centre—the insects associated with *Protea* may be peculiarly interesting.]

(*c*) *High-mountain species believed to have evolved during post-glacial time directly from parental stocks inhabiting the surrounding plateaux*: this can be illustrated by reference to the high-mountain Orthoptera and Dermaptera.

Among the Orthoptera comprising mantids, grasshoppers, etc., collected in 1926–7, Dr. Uvarov (1934) found no trace of Palaearctic influence in the mountain-fauna. The only Palaearctic elements were (i) certain species assignable to the Mediterranean part of the Palaearctic fauna, but believed to be really African forms indicating a former northward extension of the fauna associated with dry acacia thorn-scrub or savanna; and (ii) a species of the Palaearctic Eremian category, wide-spread in Palaearctic deserts, but penetrating the deep valleys intersecting the Abyssinian highlands, and ranging up to 5,500 feet.

On the other hand Dr. Uvarov concluded that the endemic Abyssinian highland species are probably recent offshoots from related forms widely distributed in Africa, mainly in the thorn-scrub country of the middle altitudes. Accordingly the montane fauna is in general very like that inhabiting other high mountains in Africa, though the species are different; all have common roots in the fauna of lower altitudes, but distinct species have been evolved through isolation. Dr. Uvarov regarded two new subspecies of Acrididae (grasshoppers), differing from their respective typical forms in their smaller size, shorter organs of flight, and darker colour, as showing the trend of development of highland from lowland species.

A like conviction was expressed by a writer on the Dermaptera (earwigs) of the high East African mountains (Menozzi, 1938). Almost all those confined to high altitudes appeared to him as African elements which have gradually ascended the slopes of the massifs, becoming adapted, structurally and otherwise, to high-mountain conditions.

But not all students of East African Dermaptera would as yet adhere to this opinion. Mr. W. D. Hincks, whose works are cited in the footnote on p. 183, recently wrote to me that 'more data are needed before we generalize'. Yet his and other writings plainly show the existence of montane species quite distinct from lowland ones. On Kilimanjaro (where an earwig has been found as high as 16,000 feet) and on Ruwenzori occur several species with wings shortened or absent, each known only from one or other of these two massifs. On the other hand a species (*Forficula sjöstedti*), originally discovered on Mts. Kilimanjaro and Meru between 6,500 and 13,000 feet, has since been found in many parts of Tanganyika, Kenya and the Belgian Congo, but always above 5,000 feet, and becoming more plentiful at still greater heights. As this species is always flightless, it might have been expected (had it been a high-mountain beetle) to have diverged into separate species on the several massifs. That it has not done so may possibly be explained by its wide range in altitude, enabling it to inhabit intervening tracts at moderately great heights, as well as the highest massifs.

Other insects of this category may possibly include the wingless Sphaerocerid flies mentioned in the footnote, p. 100, and on p. 181.

A botanical analogy ; direct evolution of the giant lobelias from forest species at lower altitudes : these extraordinary plants little resemble the small species of the genus except in their floral structure. In many cases standing over 20 feet high they are found at the high altitudes where much of the vegetation (excepting the equally striking arborescent senecios and the relatively ' giant ' alchemillas) is dwarf. But several forest-species of *Lobelia* provide a clue to the origin of the giant forms. For instance, *Lobelia longisepala,* a branching annual confined to the tropical rain-forests and having the lowest altitudinal range (1,500–3,000 feet) of any giant lobelia, is regarded as a relic of the forest species from which the ' giants ' evolved. The primitive habit of these ancestral species originating in the forest zone is believed to have been branched and glabrous, with thin scattered leaves and lax inflorescence. The dense inflorescence, unbranched stem and thick hairy leaves of the high-mountain species may well be adaptations to very high altitudes and severe climate (see Cotton, 1931 ; Hauman, 1933 ; E. A. Bruce, 1934).

Mountain-species of restricted range among other groups of animals : though the foregoing cases of restricted montane distribution, based on my personal investigations, are necessarily drawn from insects and plants, like phenomena occur among widely different animals. Two examples, from Phyla as far apart as vertebrates and molluscs, are the following :—

First, the *Colobus*-monkeys : even the *guerèza* (*Colobus guereza*), on whose grace I have touched below (p. 124), is only one representative of the genus, occurring in Ethiopia from perhaps 6,000 to nearly 10,000 feet. Another inhabits the forests of Kilimanjaro, yet another dwells in those of Ruwenzori. Other forms live respectively on Mt. Kenya and Mt. Elgon. (I leave to specialists to decide which are species, subspecies, or races. Still others frequent forests at lower, warmer levels (Jeannel, 1950 *a*, p. 227 ; de Beaux, Missione Sagàn-Omo, Mammalia, vol. vii (Zool. i), 1943, pp. 17–19).

The *Cercopithecus* met with on my journey (pp. 124, 162) are probably all referable to the grivet monkey (*Cercopithecus aethiops aethiops*), the subspecies of the African green monkey widely distributed in Ethiopia and extending into the Sudan. Other subspecies, including subsp. *zavattarii,* occur in the south of Ethiopia (de Beaux, Missione Biologica Sagan-Omo, *op. cit.* pp. 20–5), and still others in distant parts of Africa. Though this is not an example of divergence exclusively on high mountains, yet one subspecies illustrates remarkably the effect of isolation ; a stock of *C. aethiops sabaeus,* imported into the West Indian island of St. Kitts, and isolated there in a wild state for probably 200–300 years, has developed into a larger race showing differentiation in the form of the skull and teeth (Ashton and Zuckerman, 1950–1 ; de Beaux *loc. cit.* also gives cranial measurements for the subspecies in southern Ethiopia).

The numerous subspecific forms of mole-rats (*Tachyoryctes*) occurring at high altitudes are also mentioned below (p. 147). But I need not take further instances from mammals.

As to terrestrial Mollusca, my 1948–9 collection was much smaller in specimens and species than that made by Omer-Cooper and myself in 1926–7 (which included freshwater species). The late Major Connolly commented 1928, pp. 182–3) on the ' richness and extreme exclusiveness ' of the Molluscan fauna of the Abyssinian highlands as a whole. During my recent journey I did not collect freshwater shells and was struck by the scarcity of land-shells. However, I worked in forests much less than in 1926–7, while Dr. H. E. Quick tells me that snails would hardly be abundant on the acid peat-lands of the mountain-tops. Meanwhile he has given me an interesting preliminary report on the slugs. Two families are represented: Vaginulidae (Veronicellidae) by a species of *Veronicella*, specimens of which were found on top of Mt. Tola in wet herbage at the edge of a small bog, whence a stream flows over the eastern precipice a few yards away; and Limacidae by two species, one of which, at any rate near the genus *Gigantolimax*, was taken with the *Veronicella* in the bog, while the other, apparently intermediate between *Agriolimax* and *Krynickillus*, is represented by four examples found inside a hollow dying bamboo on Mt. Gughé proper, some miles to the west. If the affinity of the latter species with *Krynickillus* be confirmed, it is interesting that the type-species of that genus was discovered in the Caucasus, but that Dr. Pilsbry* has referred to it an isolated North American species found high in the ranges of the continental divide. Some genera of slugs appear to combine extremely wide distribution with extremes of discontinuity and isolation on mountains!

Acacia thorn-scrub and forest: one's thoughts pass naturally from the rain-forests on the plateaux whence the mountains rise, to the dry acacia scrub and forest occupying so much of these table-lands at the present day. But I only touch briefly on the animals and plants of these steppes or savannas. Vegetation of this kind has spread over much of the high plateaux during the period of increasing warmth and dryness since the pluvial phases, covering great expanses where mountain-forests, both mixed and purely coniferous (see p. 162), must formerly have been continuous. Flat-topped acacias are found to-day as high as 8,000 feet, mingling with the lower edge of the remaining mountain-forests (e.g. Pl. 24).

The insect-fauna of the acacia forest and scrub, though rich and varied, is less interesting to one in search of 'endemics'. Without analysing it, I have gained a general impression that it consists largely of forms more or less widely distributed in country of this type, especially on the eastern side of Africa, from Eritrea and the North Ethiopian highlands to South Africa; while many are still more widely spread in tropical Africa, and some occur also on the west side of the continent. This is borne out by certain detailed studies. Professor Hale Carpenter's analysis of the butterflies found above 1,500 metres (4,900 feet) in Ethiopia showed (1935, p. 421) the presence of over 70 forms typically West African, or the nearest allies of which occur in West Africa. That some of these haunt bush rather than true forest suggests that, in the pluvial phases of the Pleistocene, a belt of thick bush stretched from west to east even farther than the forests believed then to have extended along the rivers into the Sudan. And Dr. Guiglia, in her recent account (1950, p. 208) of the Hymenoptera of the Missione Sagan-Omo, remarks on the preponderance of forms characteristic of eastern and southern Africa, with infiltration of a tropical element extending from West Africa to the region of the lakes; she notes also the almost complete absence of affinity with the Somali coast and the extreme fewness of species proper to Palaearctic Africa.

Location and Size of Collections made in 1948–49.

As in the case of the material collected in 1926–7, all the insects and molluscs, together with the few other zoological specimens obtained in 1948–9, have been presented to the British Museum (Natural History). The dried plants were handed to the Herbarium of the Royal Botanic Gardens, Kew, the destination to which those collected in 1926–7 were sent, but with a request that the

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* See H. A. Pilsbry, 'Land Mollusca of North America', vol. ii, part 2, p. 560, 1948.

Museum should have a prior claim on duplicates. The Kew authorities also took charge of such seeds as I collected, passing most of these on to Col. F. C. Stern, who has done his utmost to induce them to germinate and grow at Goring-by-Sea—a task rewarded by scanty success in the case of plants found at 10,000 feet and higher, but only a few degrees north of the Equator.

The insects amounted to nearly 4,400 specimens (2,986 being Coleoptera). This total is small compared with about 27,000 collected by me and Mr. E. B. Britton in South-West Arabia (1937–8), and is little over one-tenth of the approximately 40,000 specimens collected by Professor Omer-Cooper and myself on the earlier Expedition to Abyssinia (1926–7).

On my second Ethiopian journey I was the only European member (though my caravan leader, Ato Negussie Effru, became a good collector). I was hindered by very bad weather, by the difficulty of getting means of transport and by greatly enhanced costs. While profiting by much kind help I also suffered (though not when away in the interior) from other causes of frustration. Consequently out of nearly six months in Ethiopia, only three were spent on the collecting-grounds. The whole of a corresponding period in 1926–7 was passed in the field, except a fortnight's necessary preparations before setting out on trek, and a short time for packing and clearing up at the end.

As the time was thus shortened, I purposely restricted myself more than ever to the special aims set forth above. But the collections are proving more interesting than I at first thought, as I have tried to show under 'Biogeographical Considerations'. Their value cannot be measured by their size, and I am strongly convinced that the expense and effort involved in obtaining them were fully justified.

Some articles of local native manufacture (collected as a private pursuit) are destined for the Museum of Archaeology and Ethnology at Cambridge.

Topographical Notes.

Previous exploration: no systematic zoological or botanical collecting had been done before in the Gughé Highlands. Moreover, having thoroughly searched the literature, I am satisfied that no full illustrated account of the country itself has been published. Before I travelled south, friends doubted whether I should find a 'Mount Gughé' at all. The name is indeed applied to a district, but 'Mount Gughé' does exist, though it is not (as previously supposed) the dominating feature of the region. In present local usage the dominating mountain is Mt. Tola (p. 143).

The routes of all travellers who published accounts of their journeys before 1913 are shown in distinctive colours on Montandon's plan (1913–14, opposite p. 8) of the itineraries of explorers of south-western Ethiopia. Some travellers along the west side of Lakes Abaya and Chamo, before and after 1913, took a relatively low-level route between the foot of the mountains and the lake-shores, following approximately the *pista bassa* of the *Guida* (p. 552). Thus, the late Sir Arnold Hodson (1927, p. 30) followed the highland route southwards in 1915 as far as Borodda, whence, owing to the mountainous nature of the country, he turned down to the lake and travelled along its shores.

In 1899, Wellby did traverse these mountains from north to south by the highland route, but the description of this countryside in his otherwise delightful book amounts to little (Wellby, 1901 *).

Col. Arthur Bentinck, D.S.O., in an interesting illustrated article (cited in my bibliography), tells how in 1933 he travelled in the neighbourhood of Lake Zwai and the adjacent lakes; he visited the forest-country of Sidāmo and, crossing the Galla Depression, went westward as far as the valley of the

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* Wellby's photograph opposite p. 180 was taken from almost the same point as the upper one on my Pl. 12.

Omo. But he did not travel south along the west side of Lake Abaya, and he has recently told me definitely that he did not visit the Gughé mountains.

I have found little relevant description elsewhere, except in the narratives of two expeditions previous to my own, those of Bòttego and of Azaïs and Chambard, both of which call for more detailed consideration.

Expedition of Captain Vittorio Bòttego to the Omo, 1895–7: though mountains were not their main object, the members of this (Bòttego's second) Expedition crossed the heart of the Gughé highlands from south-east to north-west. Starting in October 1895 from Brava on the Somaliland coast they reached Badditu, the territory east of Lake Chamo, late in March 1896. Lake Chamo or Ruspoli had already been discovered by Prince Eugenio Ruspoli in 1893. But Bòttego's party, going north along the Badditu range (i.e. the Amaro mountains), discovered on 12 May 1896 the much larger lake, Abaya, which they explored and named Regina Margherita. They then decided to follow the arduous route nearly due west through the mountains to the Omo, rather than passing through the Wolāmo country north of the lake, already occupied by hostile Abyssinian forces.

Leaving the Cullufu River, west of the isthmus between the two lakes, on 11 June, they reached the Omo on 29 June. During those 18 days they crossed the Bonghé valley and passed first south, then round to the west, of the highest mountains. North of these they descended to the Zaghé river, which they followed down to its junction with the Mazé, an important tributary flowing north-west to the Omo. Their further explorations are outside my scope.

In their vivid day-to-day narrative, the two survivors, Vannutelli and Citerni (1899, chapter x), dilate on the richness and beauty of these mountains. Their lists of products (e.g. pp. 267, 275) include some which I did not see, such as coffee-cultures (*giardini*) in the Bonghé valley and citrus on the descent from the mountains to the Omo. They noted the dense population, the scattered groups of huts and neat bamboo-fences, the basket, mat and weaving industries. But they did not halt for natural-history collecting and, though 'Mt. Gughé' is marked on their map (Tav. 3) as 4,200 metres (13,780 feet), they did not deviate from their route to climb the highest points*. On 14 and 15 June 'Gughé', *un colosso di monte,* over 4,000 metres high, lay to the north; on the 15th the explorers calculated the highest point on their route as 3,750 metres, but the massif to the north rose still higher into the clouds (probably their *colosso* was not Mt. Gughé but Mt. Tola).

Bòttego's party, pushing desperately towards the Omo, uncertain of the distance and direction, contended with rain and mist, with steep, slippery tracks and swollen torrents, which cost the lives of transport animals and the loss of equipment. The local tribesmen, armed with spears and knives, were mostly hostile, believing the Italians and their large escort to be connected with the bands of rifle-bearing Shoans and Amhara who were then adding these southern districts to the Ethiopian empire. But far from being in league with the Shoans, Bòttego was killed in a conflict with them nearly nine months later (16 March 1897) near Ghidami in Wallega†. Vannutelli and Citerni were held prisoners but later released. The fourth member, Dr. Maurizio Sacchi, who had been sent back towards the coast with material collected, had fallen in a fight near Lake Margherita some weeks before Bòttego's death. Despite the tragic fate of half the European *personnel,* the results were extremely important. Even in zoology, the late Dr. Gestro's preliminary synopsis of the collections made during only the first half of the journey showed over 1,300 species, including many then new to science (R. Gestro in Vannutelli and Citerni, pp. 595–632, pls. i, ii ; see also Sclater, 1899).

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* In an anonymous note on Bòttego's Expedition (*Geographical Journal,* xv, Jan. 1900, pp. 50–2), they are said to have 'passed' (not climbed) a massive peak named Gughé, nearly 14,000 feet high.

† No warning had reached him of the disaster at Aduwa over a year previously (1 March 1896).

Rév. Père Azaïs and M. Chambard : as recounted in their ‘ Cinq années de recherches archéologiques en Éthiopie ’, these explorers made the circuit of the lakes in 1926, but in the opposite direction to that which I took in 1948. They narrate (livre iii, chapter 4) in lively phrases their trek northwards from Gardulla through the Gughé highlands to Chencha and thence to Sōddu, amid the discomforts of the Rains. Their brief but vivid incidental descriptions of the countryside are illustrated with some striking landscape photographs (e.g. pl. 90, figs. 1 and 2 show the escarpment of Mt. Tola, though they do not mention that name, with waterfalls in spate). The great book produced (1931) by these genial archaeologists (with whom I travelled homewards from Djibouti in February 1927) is hereafter cited under ‘ A. & C.’ Besides the main subject it includes an Appendix (pp. 321–32) by Jean Cottreau on Jurassic fossils from the Harar district.

Maps : though the country is still very incompletely surveyed, I had the most recent maps available. My route-map (p. 110) is adapted and reduced from parts of two sheets (G.S.G.S. 2465) in the 1 : 1,000,000 series, namely NB. 37 (4th edition) and NC. 37 (2nd ed.). I also used the following four sheets (all G.S.G.S. 4355) of the 1 : 500,000 map :—N.B. 37/1 (Sōddu, 6th ed.) NB. 37/2 (Dallé, 5th ed.), NB. 37/4 (Stefanie, 4th ed.), NC. 37/5 (Addis Ababa, 3rd ed.) ; my fig. 6 (p. 145) is adapted and slightly reduced from parts of the Sōddu and Stefanie sheets.

Altitudes : in this important matter, as I travelled long distances in varying weather, and had no ‘ control ’ at a fixed point, my observations by aneroid and (in a few cases) by boiling-point indicate mainly relative ascents and descents. The altitudes of a few of the places visited had been determined by triangulation. For the rest, the approximate altitudes of the collecting-stations have been decided from the contours on the maps cited above, some of the figures arrived at being modified by my own readings. I was advised that this compromise was the best practicable.

Though a wish to reach high places might have caused me to exaggerate altitudes, yet on both journeys my observations usually led to my placing the highest points attained considerably lower than they afterwards proved to be. I have, however, drawn attention to an error in the opposite direction. Though Mt. Damōta is shown on map NB. 37/1 as only 7,644 feet, I could not make it less than nearly 10,000, while the height is, in fact, to be taken as 10,400 feet. Likewise my independent observations led me to regard Chencha as situated at about 8,900 feet, thereby agreeing with the 2,732 metres (8,963 feet) given in the *Guida* (p. 551), though on the map it is shown just below the 8,200-feet contour.

The following boiling-point observations were taken with a hypsometer apparatus (the loan of which by the Royal Geographical Society I here acknowledge). Distilled water was used in each case. The shade-temperature on the bare grassy summits of Mt. Damōta and Mt. Gughé was recorded in the shadow of my own body, as there was no other object to cast a shadow.

Place	Date and time	Boiling point	Air-temperature in shade
Summit of Mt. Damōta (10,400 feet)	5.xi.1948, 10 a.m.	Just below 194° F.	62° F.
Sudan Interior Mission Station, Sōddu (about 6,800 feet).	11.xi.1948, 8.45 a.m.	Just below 201° F.	63° F.
Chencha (about 8,900 feet)	29.xi.1948, 6 p.m.	197° F.	55° F.
Summit of Mt. Gughé (over 12,000 feet)	21.xii.1948, 10.45 a.m.	Just below 194° F.	64° F.

The altitudes in the left-hand column are those arrived at partly by other methods, as explained above. I must leave others to interpret the readings, especially the identity of those taken on the tops of Damōta and Gughé, over six weeks apart. Mt. Gughé is clearly much higher than Damōta, while the highest point of the whole Gughé-Tola massif, some distance north-east, is to be taken as 13,780 feet. On both occasions the sun shone brightly after a cold night. On Damōta I was hampered by high wind.

Lakes Abaya and Chamo: besides the extraordinary difference in colour between the two lakes, and the apparently far greater evaporation from Lake Chamo, the latter lies about 172 feet lower than Abaya (p. 138). Exceptional rainfall is believed to cause occasional overflow from the larger to the smaller lake at the western end of the isthmus between the two (*Guida*, p. 553).

After some hesitation over the name of the larger lake, I have decided to call the two lakes in this Report by their best known native names, Abaya and Chamo, rather than using the Italian names given them by Bòttego's Expedition, respectively Margherita and Ruspoli*. This involves an inconsistency, for on labels printed before this Report was written and attached to specimens collected near the larger lake, its name appears as Margherita. But Abaya seems more suitable in the text; it is, moreover, the name used by Buxton (1949), and it appears on the map in Rey (1923).

Several native names are in fact used for each lake, and not always in the same sense, by local inhabitants of different races. *Abaya* was, according to Hodson (1927, p. 32), applied locally to both lakes, as was also the name *Pagadé*, both being general terms for 'great water'; he also noted that the name *Chamo* was used by only one tribe near the south-east corner of that lake. The isthmus, called 'God's Bridge' in the native tongues, has also been termed 'The Elephants' Bridge' by Europeans (*Guida*, p. 552; A & C., pp. 258, 263).

The inland nature of the drainage and other features are apparent from the route-map itself. (i) The general level of the region traversed falls away southwards from the starting-point at about 8,100 feet in Addis Ababa to the crossing of the Sagan River, south of Konso, at perhaps little over 3,000 feet. (ii) The many rivers touched or crossed on my route all drain into lakes, either directly or as tributaries of larger systems. The only rivers on the route-map belonging to systems reaching the sea are the Abbai (Blue Nile), with its tributaries the Adabai, Muger and Guder in the extreme north; and some of the numerous affluents of the Webbi Shebéli system, flowing towards the Indian Ocean, indicated (but not named) in the east.

Weather Notes.

In summarizing the notes recorded as regularly as possible, though with unavoidable gaps, during both my Expeditions, two series of observations must be kept distinct. The first series relates to the high plateaux of central Ethiopia, where (as in most of the highlands) there is a marked alternation of summer 'Great Rains' and a long dry season. Some statistics have been published concerning this part of the country, particularly the capital, though I have had access to no very recent data.

The second set of observations relates to the southern districts visited in 1948–9, which present noteworthy peculiarities, especially in the Gughé mountains, where rain is expected on and off during most or all of the year. I have been unable to analyse more than partially the meteorological data

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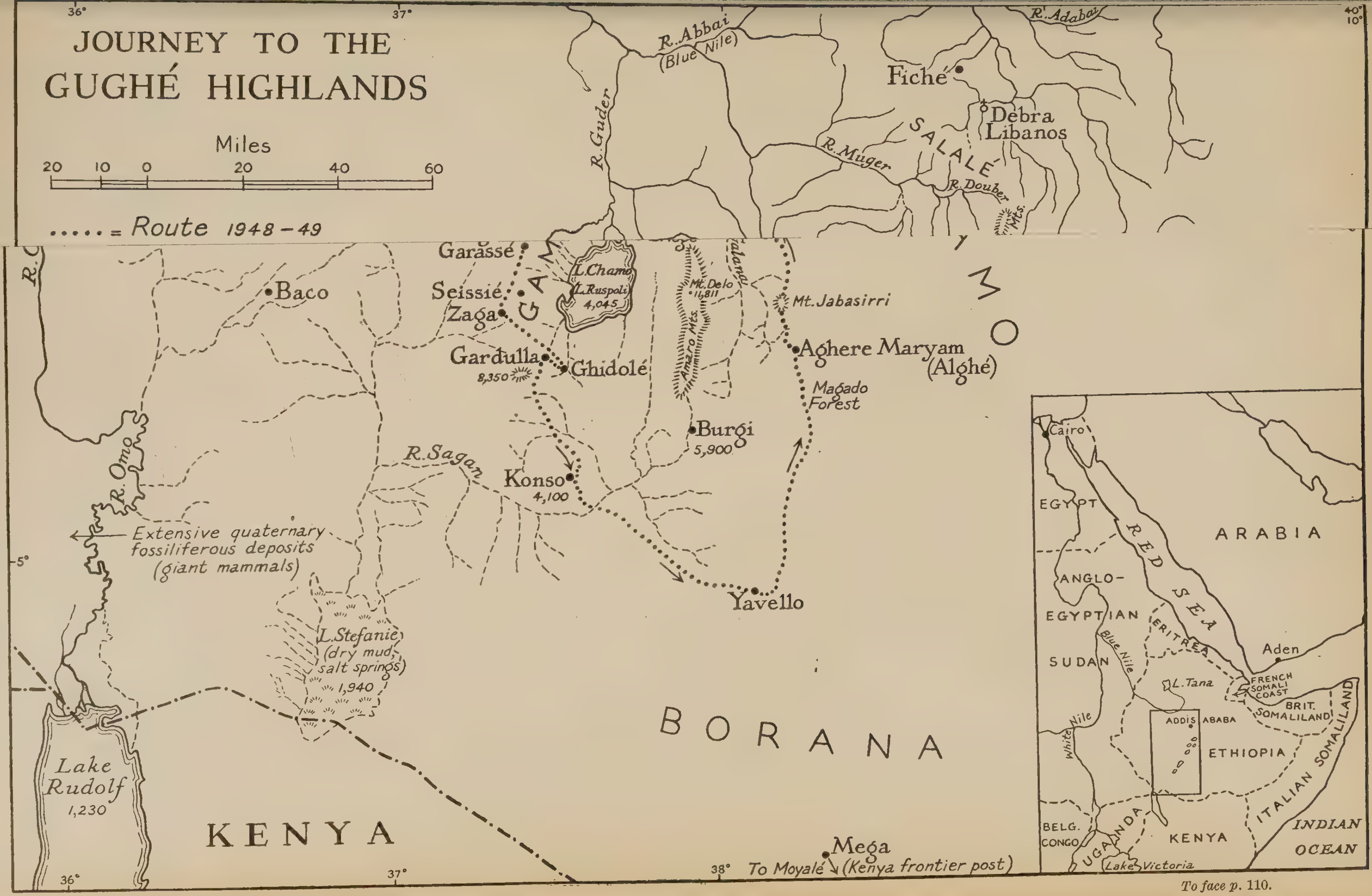
* Ruspoli, on discovering Lake Chamo in 1893, named it Lago Umberto after the King of Italy. Bòttego, having reached it in May 1896 and then discovered the larger Lake Abaya, which he named Margherita, re-named the smaller lake Ruspoli (*Guida*, pp. 552–3). Ruspoli, it may be added, was killed by an elephant later in 1893, and buried at Burgi, near the southern end of the Amāro mountains (*Guida*, p. 561).


JOURNEY TO THE GUGHÉ HIGHLANDS
Miles
20 10 0 20 40 60
..... = Route 1948–49
36°
37°
38°
40°
10°
5°
R. Abbai (Blue Nile)
R. Adabai
R. Guder
R. Muger
R. Douber
Mts.
Fiché
Debra Libanos
SALALE
GAMO
Garassé
Seissié
Zaga
Gardulla
8,350
Ghidolé
L. Chamo (L. Ruspoli) 4,045
Mt. Delo 11,811
Amaro Mts.
Galana
Mt. Jabasirri
Aghere Maryam (Alghé)
Magado Forest
Burgi 5,900
Konso 4,100
Yavello
Baco
R. Sagan
R. Omo
R. C
Extensive quaternary fossiliferous deposits (giant mammals)
L. Stefanie (dry mud, salt springs) 1,940
BORANA
Lake Rudolf 1,230
KENYA
Mega
To Moyalé (Kenya frontier post)
Cairo
EGYPT
ARABIA
RED SEA
ANGLO-EGYPTIAN SUDAN
Blue Nile
White Nile
ERITREA
Aden
L. Tana
FRENCH SOMALI COAST
BRIT. SOMALILAND
ADDIS ABABA
ETHIOPIA
ITALIAN SOMALILAND
BELG. CONGO
UGANDA
Lake Victoria
KENYA
INDIAN OCEAN

To face p. 110.

recorded in 1896 by Bòttego's Expedition (D. Peyra, *Osservazioni meteorologiche e loro discussione,* forming Appendix iv in Vannutelli and Citerni, pp. 537–73) and have relied more on descriptive remarks in the narrative of the survivors, also in that of Azaïs and Chambard (both these works have been cited above, pp. 108–9, and allusion is made below to the weather-comments contained therein).

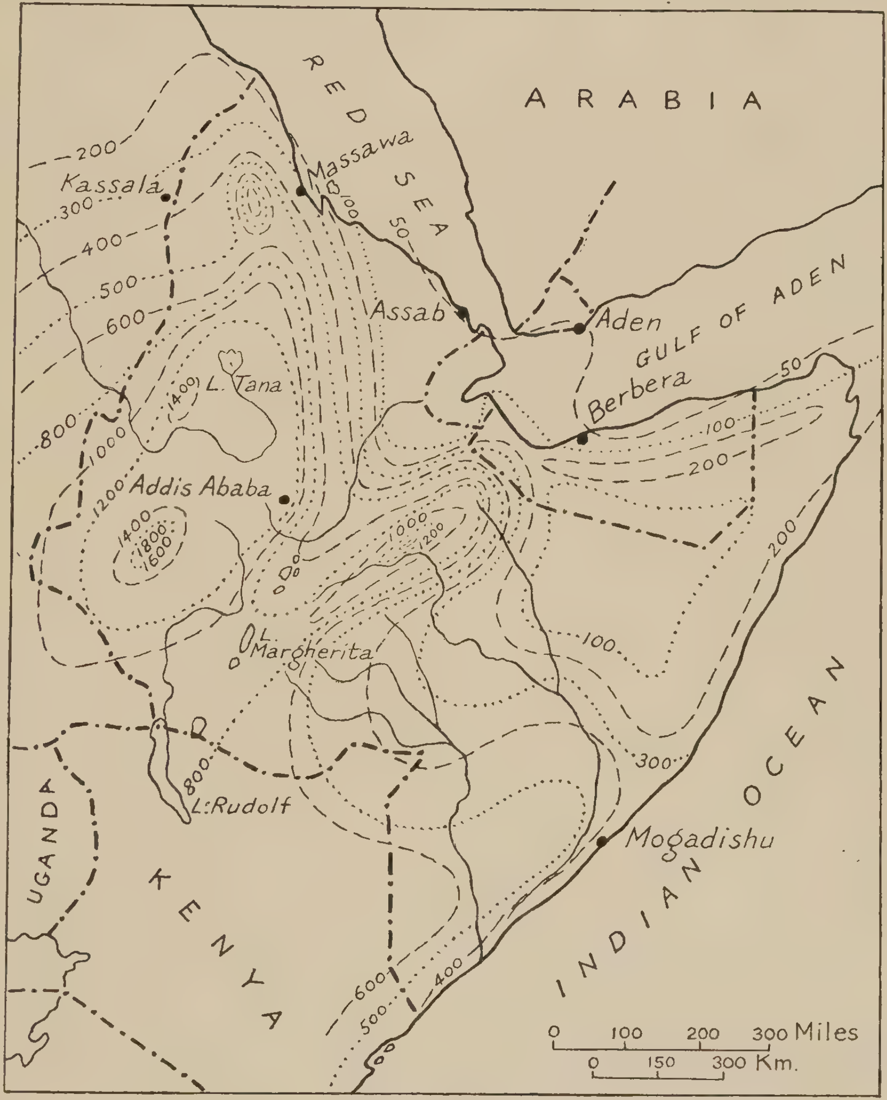


FIG. 4.—Distribution of rainfall in Ethiopia, Eritrea and Somaliland.

A few remarks on the climate of Ethiopia as a whole will set my personal experiences in a clearer light.

Rainfall: Fig. 4 (adapted from *Guida,* p. 47) shows the mean annual rainfall in different parts of Ethiopia, a vast country with almost every gradation in climate, from the low Danakil desert in the north-east, among the hottest and driest parts of the world, to the temperate highlands. According to this map, Addis Ababa (7,900–8,400 feet) has an average rainfall over 1,200 millimetres (48 inches). Monthly and yearly totals published by Sir Charles Rey (1927, p. 276) for most of the years 1902–26 (inclusive) show annual totals varying between 945 and 1,553, and averaging 1,192, millimetres.

The districts with the greatest annual mean, 1,400–1,800 millimetres (56–72 inches), lie a long way west of the capital, between Jimma and Gambela*. The Gughé Highlands are situated in an area receiving only 800–1,000 millimetres (32–40 inches), though the mountains themselves almost certainly get far more rain.

In the Ethiopian highlands the year is roughly divided into two seasons, the Rains, usually lasting from May or June till the end of September or later, and the Dry Season. The 'Little Rains', supposed to last up to six weeks in February, March or April, are really very unreliable. In some years they do not come at all, in others they occur, but vary from intermittent showers to heavy rains continuing without interval into the Great Rains.

The Ethiopians call the Rains *Karamt*, the Dry Season *Bagā*. The classical Ethiopic word *karamt* is (I learn from Mr. C. F. Beckingham) used to translate 'winter' into Ethiopic in the Bible, and some early Portuguese writers on Ethiopia also call the rainy season 'winter'. But *Karamt* and *Bagā* do not correspond with winter and summer as understood in northern latitudes. For the basic idea of *Karamt* is rain, hence the season of growth and fertility. On the other hand the lowest night-temperatures in the year may be expected on the high plateaux during *Bagā*, the Dry Season, when also snow occasionally lies on the northern mountains; for despite the heat and brilliance of the sunshine, radiation at night is then intense.

My friend the Rev. A. F. Matthew, many years resident in Addis Ababa, told me he regarded the year as including two winters, a wet and a dry. Anyhow, from a naturalist's standpoint it may be said that there are two spring-times, at the beginning and end of the Rains. I have twice experienced the latter, a season when insects and flowers abound, though to my regret I have not experienced the other spring-time, when different species appear, which I have never seen (witness Poncet's graphic, if not botanically quite accurate, description (p. 145) of the flowers in northern Ethiopia in May 1700). In much of central Ethiopia crops are harvested at the end of the Rains and the land is ploughed before fresh sowing. Such few notes as I have on the nesting-season of birds and its relation to the Rains will be found on p. 146.

Contrast between the latter part of the Rains in central Ethiopia in 1926 *and* 1948: as the Rains in 1948 lasted a month longer than in 1926, I at first regarded them as abnormal and the season of 1926 as normal. But it seems safer only to say that in 1948 the Rains were very heavy and lasted longer than in some years, without concluding that this was exceptional. Fine seasons may perhaps be remembered while less favourable or bad ones are forgotten, even though the latter may be quite as numerous, and thus a bad season may be pronounced 'exceptional'. (I am confirmed in this view by a timely warning from a distinguished Himalayan explorer, Professor Kenneth Mason. He tells me that in crossing a certain high pass in five different years he always met heavy snowfall early in May, though snowfall at that point should, according to previously accepted conclusions, have ended in March; so that he met with five 'abnormal' seasons).

Turning then to the weather which I in fact experienced: in the finer season of 1926 I was told, on arrival at Addis Ababa in the first week of September, that the Rains before that date had been heavy and nearly continuous, i.e. starting early and with no interval between early 'Little Rains' and later 'Great Rains'. Nevertheless while encamped (21 September to 12 October) at Jem-Jem Forest, west of Addis Ababa, we could rely for our collecting on several hours of morning sunshine, followed by a thunderstorm and a wet afternoon. The Rains ceased, as they traditionally should, just before the Maskal (Holy Cross) Festival, the local celebrations of which took place on 26–28 September. In October and November I met with short though violent recurrences of bad weather, with thunder and sometimes hail, in the mountains. Thereafter, I had only fine bright weather till I left Ethiopia at the end of January 1927.

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* Even this greatest annual rainfall is moderate compared with 160 inches at the altitude of maximum precipitation, about 7,800 feet, on Ruwenzori, or 90 inches on the volcano Karissimbi in Kivu.

In 1948 the Rains were heavy and prolonged. The state of the main routes in the south was one cause of my not starting from Addis Ababa till 15 October. Such damage had been done that motor-travel beyond Sōddu was still impossible in November, so I had to continue to Chencha by mule-caravan (this I hold to have been a positive advantage). At the local celebration of the anniversary of the Emperor's coronation at Sōddu, 2 November, the Coptic clergy asked the people to pray for fine weather as agriculture was being hindered.

In the capital, during a chilly, misty fortnight after my arrival on 20 August, many days were sunless or sunny intervals occurred, if at all, in the early or late afternoon. Some European residents thought that the rainy season had worsened in Addis Ababa in recent years, there being not necessarily more precipitation but more sunless days. One friend attributed this to the rapid increase in size and number of the eucalyptus-trees among which Addis Ababa is embowered, but I do not know if this view would be supported by statistics. Later, the Rains assumed a more usual stormy character. Torrential thunderstorms fell on five afternoons between 2 and 9 October, the last continuing about three hours; after one storm large hailstones were piled a foot deep in gutters near the Hôtel d'Itégué (my ' base '), though other quarters of the straggling city remained dry. The customary bonfires lighted in the evening of 10 September before the New Year* were quenched by a deluge, but the dark countryside, viewed from the top of the Entotto range, was fitfully illumined by lightning.

Afternoon or evening thunderstorms following hot, bright mornings at Sōddu on five days (23–28 October), and the accompanying abundance of night-flying insects, are mentioned on p. 133. This late wet spell after a fine interval was general over much of the country. Minimum temperatures noted later at Sōddu (6,800 feet) for the nights 9–10, 10–11 and 11–12 November were, respectively, 50°, 49° and 58° F. (the thermometer was placed outside a window in Dr. Barlow's house). These nights were fine, but the two former very windy. During the hot dry afternoon of 11 November the shade-temperature was 78° F.

On top of *Mt. Damōta,* during a fine spell, I recorded minimums for the fine, clear nights of 4–5 and 5–6 November, respectively 39° and 38° F. at about 10,000 feet. On the extreme summit (10,400 feet), 5 November, 10 a.m., the shade-temperature was 62° F. (see above, p. 109).

Travelling south from Sōddu to *the southern districts,* a thunderstorm was encountered in Mt. Humbo on the night of 17–18 November. On grass-land near Ezo (about 9,000 feet) heavy dews fell on the nights of 20–21 and 21–22 November. On the former night the minimum was 44° F. (in this and all succeeding records the thermometer was placed about two feet above the ground on a box under the outer fly of the tent). At Chencha (8,900 feet) the days, 22 November to 2 December, were fine, though heavy clouds usually gathered in the afternoon over the mountains east of the lake. Rain did not always reach Chencha, but thunderstorms broke on several evenings or at night; during one on 24 November hail fell, and the minimum that night was 44° F.

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* Maskaram 1st, the Ethiopian New Year, falls on 11 September or, following their leap year, on 12 September.

In the *Gughé Highlands* rain is expected, on and off, during most of the year. Père Azaïs was told (1926) that it is looked for during eight months. I was told that 'it rains thirteen months in the year'; my local informants alluded to the thirteen months in the Ethiopian calendar*. Whichever be nearer the truth, evidently there is no long dry season. The annual average of 32–40 inches shown for the area in which the mountains lie may be correct for the middle altitudes, but the mountains themselves must receive far more rain.

During the month (3 December 1948 to 2 January 1949) spent in the district, a fine, brilliant and very clear spell lasted from 3 to 9 December. But at my highest camp on the shoulder of Mt. Tola, about 10,600 feet, 10 to 26 December, we endured raw, damp weather, with thunder on two nights. Clouds scudding across the lakes on the east wind at times enveloped the camp. Even with a waterproof ground-sheet and baggage raised from the ground on stones, it was difficult to keep specimens, apparatus and clothing dry. Yet the total rainfall in these mountains may not be enormous. The torrential showers begin and end abruptly, often start again suddenly after a sunny interval, but do not usually last very long. Through the clouds driving over the camp, the sun could often be seen shining on the acacia-scrub several thousand feet below.

After I left Mt. Tola on 26 December, dull, sunless weather, with low mist and showers or heavy thunderstorms in the afternoon or at night, continued till I quitted the southern slopes of the Gughé mountains on 2 January 1949. Yet barley, though still green on the highest terraces (11,000 feet), was being harvested in the valleys (9,000 feet) in late December. Agricultural work in the intensively cultivated valleys and on the steep terraced slopes is adapted to frequent wet weather.

At Dita, on the east side of the mountains, the minimum temperature (4–5 December) was 36° F. At the camp on Mt. Tola the minimums were about 40° F., though the damp cold was very penetrating. Frost only occurred on the fine clear night of 20–21 December, but unfortunately I kept no note of the exact temperature. I had expected colder nights, remembering my experiences much farther north in November and December 1926. Then, on the plateau north of Addis Ababa, at a little over 8,000 feet, I had seen hoar-frost and thin ice in the early morning, and my minimum-thermometer, placed in a tuft of grass, had recorded 25° F. on the night of 18–19 December. This was in dry, still weather; but on the night of 21–22 November, during very bad weather on Mt. Chillālo at about 10,000 feet, the temperature also fell nearly to 28° F.

Leaving the Gughé Highlands on 2 January 1949, I saw no more rain till I reached Dilla in mid-January (according to Azaïs and Chambard (pp. 259–60) the Rains in the district south of Lake Chamo begin late and last only from early September till the end of October). At Ghidolé (5,000 feet) the days 4–8 January 1949, were fine, still and hot; thick haze hung over Lake Chamo, veiling the surrounding mountains. At Konso, 9 January, the shade-temperature reached 97° F.—a sudden transition from the mountain climate in a bare week.

Northwards from Yavello through Sidāmo, and during my final stay in Addis Ababa from 28 January till I left Ethiopia on 16 February 1949, dry-season conditions prevailed, bright hot sunshine but high dust-laden easterly winds. The exception was at Dilla (5,100 feet), 15–25 January, where thunder-clouds gathered over the mountains to the east on several afternoons, and the rather oppressive heat in the town was twice alleviated by evening showers. But these did not turn out to be precursors of general early 'Little Rains' which, as stated, are irregular.

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* Their calendar has twelve months of thirty days and a short thirteenth month of five (in leap year six) days; see Rey, 1923, pp. 161 sqq. It recalls the calendar introduced in France, 1793, by the First Republic.

Thus I met with frequent rain and thunder in October, November and December, and a little in January. Père Azaïs and M. Chambard, following nearly the same route in the reverse direction in 1926, had even more wet weather. Setting out earlier, they met the late Rains at Gardulla in southern Gamo in mid-September and frequent thunderstorms in the mountains till they reached Wolāmo in October. They too noted the abrupt beginning and ending of the showers and their torrential nature, in terse phrases such as 'nuit diluvienne' and 'miracle ! it n'a pas plu la nuit' (A. & C., pp. 259–64).

Similarly Bòttego's party in 1896 recorded much wet weather in the months of May and June. As stated above (p. 108) they crossed the Gughé mountains from south-east to north-west between 11 and 29 June. Not only did the survivors graphically describe the bad weather and swollen torrents, but the table in Peyra's meteorological Appendix (Vannutelli and Citerni, p. 571) records some rain on 26 days in May and 22 in June, the days of heavy rain being 10 in May and 14 in June ; storms (*temporale*) occurred on 13 days in the former and seven in the latter month ; the rain was described as slight (*pioggia poca*) on 16 days in May but only on eight in June, while of fine or almost fine days (*giorni sereni o quasi*) May provided only two and June apparently none. My own experience confirmed that of my predecessors. Gughé is indeed a rainy corner of Africa.

Note on snowfall in northern Ethiopia : evidences of former glaciation are mentioned above (p. 90). I am here only concerned with the vexed question whether snow falls anywhere in Ethiopia nowadays, a matter which interests me although I have been unable to visit the north, and to which I contribute further references.

In some cases the supposed snow on the Simien mountains has proved on nearer view to be frozen hail, which may lie for several days, glistening in the sunlight. In other cases what appeared as snow turned out to be not even hail, but the play of sunlight on short dry grass (H. C. Maydon, 'Simen*, its heights and abysses', 1925, p. 63).

That real snow does occasionally fall and lie on these mountains is conclusively proved by Major R. E. Cheesman in a letter to *The Geographical Journal* (cxv, June 1950, pp. 268–70). He cites a companion of Henry Salt as having been on Simien in a heavy fall of snow which 'quietly descended in large flakes' (H. Salt, 1814, 'A voyage to Abyssinia in 1809 and 1810'), and also the evidence of Major H. E. Hebbert, R.E., and his wife, who snow-balled one another and photographed the thick snow lying in patches only a few years back (date not given).

The two following statements, apparently overlooked, probably refer to real snow :—

A. B. Wylde (1901, pp. 152–3, 188–9), who saw the Simien mountains during nearly every month, was convinced that snow lay in the cold season for days on end, extending much lower on some days than on others ; he described the colours cast by the sun on the snow on the northern crest of Ras Dashan, and big waterfalls (seen through field-glasses), of greater volume when sunshine was melting the snow.

Secondly, General Gordon's biographer describes how Gordon in 1879, after an unsuccessful mission to Negus Yohannes at Gondar, was forced by the Negus to travel over the snow-covered mountains to Massawa between 18 November and 8 December, instead of going as he wished direct to the Sudan *via* Kassala (Sir W. F. Butler, 'Charles George Gordon', 1889, chapter vi).

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* I use one of the accepted English spellings, 'Simien'. But Wylde and other English writers used 'Semien', Maydon wrote 'Simen', and Bent (1893) 'Semen'. The *Guida* and other recent Italian writings give 'Semién', and Dr. Jeannel (1950 *a*) writes 'le Semiène'. Compare Appendix C (p. 176).

Conditions of Travel, Costs and Currency.

Conditions have changed swiftly in Ethiopia, and are still changing. Therefore it is worth while to compare the methods employed, and to record just what were the difficulties encountered, on the two journeys.

The route-map of my recent journey also includes the principal places (except Harar) visited during the earlier expedition. But I have not complicated the map by adding the routes followed in 1926–7. These have been fully shown by Professor Omer-Cooper (1930, p. 201). Moreover, places which it was quite an undertaking to reach from the capital in 1926 have now become to residents a matter of simple excursions.

The journeys in 1926–7 amounted altogether to some 500 miles. As no roads for wheeled traffic then existed outside Addis Ababa, our mule-caravan started from the Imperial Hotel, in the heart of the capital. We motored to the outskirts at the beginning of our first trek, in a car belonging to the late Blatengeta Heruy. Otherwise the whole 500 miles were covered on horse- or mule-back, or by walking when our mounts were tired. Our caravan, not exceptionally large for those days, numbered up to 20 persons, including ourselves, our servants and six *zabanyas* (guards, with four rifles), our *nagadi* and his three muleteers; with five riding-mules, a horse and about 19 pack-mules. The number of men and animals varied slightly in different parts of the journey. For several weeks also Professor Omer-Cooper and I were apart, while he went to Hora Abjata and Lake Shala with a larger party, and I, with a smaller number of men and animals, to Mt. Chillālo.

On the other hand, in 1948–9 I travelled approximately 810 miles, about 670 in hired motor-lorries. The remaining 140 miles (excluding détours in the mountains) covered by mule included the 60 miles from Sōddu to Chencha, normally motorable, though the Rains of 1948 had rendered the route impracticable for motor traffic.

Including excursions and short journeys from camp to camp in the mountains, my total mule-riding must have amounted to considerably over 140 miles. During more than six weeks' mule-trekking we fell back into the old way of reckoning distances by 'mule-hours' rather than miles or kilometres. But I found the old method, a good mountain-mule carefully picking his way, far less fatiguing than motoring over tracks where, during the Rains, the lorry was bogged in black mud, or (later) where we jolted over rocks and rushed at steep hills, though usually forced to stop abruptly short of the top, with the water in the radiator boiling over. In those southern districts good modern roads had not yet taken the place of the old trekking-system. Sometimes too it was very difficult to get any means of transport at all.

Naturally, in 1948–9 I traversed much longer distances in a short time, and visited districts which we did not even contemplate in 1926. Moreover, my Ethiopian personnel comprised only five men, *plus* an Eritrean hospital-dresser sent by the Ethiopian Ministry of Health, who watched over the health of my party and set up temporary dispensaries for the country people near our stationary camps. To the permanent retinue must be added the driver and his mechanic on each of the lorry journeys, while for the mule-safari I engaged three different *nagadis*, respectively from Sōddu to Chencha, from Chencha to Bonghé and from Bonghé to Ghidolé. In each case a contract for five riding mules and twelve pack animals, drawn up by the local Government secretary, was signed by myself and thumb-marked by the *nagadi* in the presence of the provincial Governor or district-chief. But this did not prevent minor incidents, such as the *nagadi* being up to two days behind the time appointed to assemble his beasts and start, or long and vociferous argument over the weight and arrangement of loads. Such things still happened much as in the past!

Excepting some lonely places of ill repute, I have roamed freely on both expeditions, carrying on my work without hindrance when travelling from place to place, or during excursions from stationary camps. When on the move, I made a rule of trying to push ahead at the beginning of the day's trek. But too often the main body of the caravan straggled past while I was collecting specimens at some favourable spot. Then, especially during the earlier expedition, the *nagadi* would forge ahead and pitch camp on a site suitable to himself but less so to his employers ; as when he landed us among lush grass, excellent grazing but infested with hordes of mosquitos, beside Lake Zwai. But the consequent risk of malaria was not the only risk. On the following morning (3 November 1926) both *nagadi* and caravan-leader were very anxious lest a muleteer, who disappeared for some time, lost in dense bush while searching for strayed mules, might be attacked by local tribesmen unfriendly to men from the capital. Next day I, too, had the uncomfortable experience of becoming separated from the caravan in that same bush, not very tall but extremely dense, and threaded by a confusing network of small paths. With a few men I wandered round and round for hours, tired, hungry and thirsty, while our local ' guide ', who had quite lost his way, was only just prevented from abandoning us, till at length we struck a main track.

Finally, a few weeks later (28 November 1926), I had my one and only glimpse of *shiftas*. Having travelled round the western side of Mt. Chillālo, and wishing to cross the pass between it and the range to the east, I was hustled over the high, desolate, heath-covered ' saddle ' between the two. Omer-Cooper and his part of the caravan having gone south to Lake Shala, my own party included only two *zabanyas* with rifles. So several local minor chiefs accompanied me, bringing two more riflemen and four spearmen. The chiefs allowed only twenty minutes halt for lunch and collecting insects at the top of the col, though I longed intensely for another half-hour in which to continue collecting on that wide moorland of black, peaty soil, between the steep eastern slopes of Chillālo and the western declivity of the long range, all covered with dull green tree-heath and with patches of silver-grey alchemilla on their tops. Instead, we hurried in single file through the tall heath, as high as the waist or even shoulders of a mounted man, hastily dismounting at places too boggy or rocky to ride over and quickly mounting again. The nervousness of my escort was due to a group of ten or more men, who had partly descended the slopes of Chillālo and who, after viewing us from above, turned and went up the mountain again. Their appearance was that of ordinary peasants and their weapons were not clearly visible at a distance. But I was assured that they were bandits, known to be frequenting Chillālo, who would have attacked a weaker party of travellers. Presumably they decided not to risk molesting a European escorted as I was.

In 1948–9 greater security reigned in the countryside as a whole. We carried no rifles, and the caravan included only one *zabanya*. In 1926–7 one of the *zabanyas* was on watch, by turns, throughout the night. In 1948–9 this was no longer thought necessary, though our single *zabanya* and my personal servant (with a revolver) slept one on either side of me, under the outer fly of the tent. The places where special precautions were needed were not, in this case, the highest heath-covered mountains, but the lowest parts of the route. During the too-long ride from Mt. Humbo to Borodda on 18 November, my *nagadi* insisted on the caravan keeping compactly together where the track, after a descent nearly to lake-level, traverses a great uninhabited expanse of very tall dense grass—a stretch patrolled by police, not local but drawn from the Amharic-speaking provinces farther north. And when the huge lorry belonging to the Governor of Gamo-Gofa, heavily loaded with merchandise, with myself, my men and baggage superimposed and several policemen among the passengers, crossed the Sagan river by night (10 January 1949), we were met by a number of police on foot, who ran beside us till we were clear of the dense forest bordering the river.

Expenses: owing to the number of men and animals needed for a moderate-sized caravan, trekking in high Ethiopia was not a cheap pastime even in 1926. The total expenses of Omer-Cooper and myself from leaving England, 17 August 1926, till my return home, 15 February 1927 (he returned in December 1926), amounted to about £865, of which nearly £80 was recovered by the sale in Addis Ababa of tents, camp-furniture and surplus stored food. The great rise in costs is reflected in my having spent more by myself in 1948–9 than the two of us together did on the earlier journey; while had I not curtailed my programme for reasons given elsewhere, I should have had to seek supplementary resources from England. Yet about half the sum recovered by sale of camp-kit in 1927 was still obtainable in 1949.

Though expenses generally, in particular fares to and from England, living-costs in Addis Ababa, and wages, have greatly increased, travelling in the interior, especially the part done by mule-caravan, was not proportionately the heaviest item. A few examples must serve to compare the cost of travel in the interior on these two journeys, though close comparison is difficult owing to the change in conditions and diminished value of money.

I have both times contracted with a *nagadi* to supply riding- and pack-animals and muleteers. In 1926 we kept the same *nagadi* (a rascal, but efficient according to local methods) for nearly twelve weeks during our main trek. He got a fixed sum *per* mule *per* day when trekking, and a smaller sum *per* mule for each day spent in stationary camp. His total payment for the twelve weeks amounted to 777½ Maria-Theresa dollars, nearly £80. The total cost of the whole safari was 1,586 M.T. dollars, or nearly £159, £53 for each four weeks.

The monthly wage-bill of the thirteen men directly employed by us (caravan-leader, six *zabanyas*, a *sais* and a personal servant apiece, and cook and cook's boy) amounted to 149 M.T. dollars, approximately £15, excluding small advances for shoes and blankets and a monthly allowance of three to five M.T. dollars (roughly six to ten shillings) *per* man for rations when away from Addis Ababa.

Compare with this the monthly wage-bill in 1948–9 of only five men permanently employed: it totalled 350 Ethiopian dollars (£35 0*s*. 0*d*.), each man receiving an extra dollar (2*s*.) per day when away from the capital. As to the several *nagadis* with whom I contracted, the following example will suffice: for the 60 miles mule-transit between Sōddu and Chencha, I paid 9 dollars (18*s*.) *per* mule, or 153 dollars (£15 6*s*. 0*d*) for the seventeen animals. We travelled on five days and spent two more days at camping places; on these stationary days the *nagadi* and his six muleteers got an extra half-dollar (1*s*.) apiece for rations. The other mule-stages were conducted at about the same rates of payment.

In 1926 a *wass* (guarantor) had to be found for each man before leaving the capital. The thirteen papers, each thumb-marked by the guarantor and the man guaranteed (or signed by the few who could write), were deposited at the British Legation. With scarcely an exception the men fully satisfied us.

In 1948 I could not find guarantors in the strict sense for all my men. Four of them were middle-aged, the fifth was my personal servant's son. Ato Negussie, my caravan-leader, had acted in the same capacity 22 years before. They protested that they owned houses and land in Addis Ababa, and were therefore unlikely to abscond. The Ethiopian Secretary at the British Legation, Ato Emmanuel Gabré Sellassié, after interviewing them, warmly approved my choice of retainers of an older, simpler type compared with many of the smart young people now frequenting the capital. He exclaimed, 'I don't know how you got them together!' But he rightly insisted on written guarantees or at least testimonials, which were at length produced.

As to motor-transport, I had to charter a whole lorry from Addis Ababa to Sōddu in October, as regular traffic had not been resumed owing to the Rains. The charge for 230 miles was 300 dollars (£30 0*s.* 0*d.*); a week was spent over the journey, including two halts of a day apiece. But in returning from Dilla to Addis Ababa in January, also about 230 miles, a passage for myself, my men and all our kit, in a lorry partly loaded with merchandise cost only 171 dollars (£17 2*s.* 0*d.*). For transit from Yavello to Dilla, about 125 miles but occupying three days, I was at the mercy of competing Arab owner-drivers, the least expensive terms offered being 400 dollars (£40 0*s.* 0*d.*) for the hire of a Ford truck.

Currency: in 1926 the unit was the Maria-Theresa dollar, newly minted in Europe but bearing the effigy of that Empress and dated 1780. We drew these dollars from the Bank of Abyssinia*; their value in terms of sterling fluctuated from day to day, or even within the day, hence I had to be alert to draw on my sterling account and buy dollars when the exchange was favourable. The rate varied between 9.20 and 10.10 dollars to the £.

Sacks of these heavy pieces had to be carried on trek, locked in our mule-trunks, or I used a strong holland boot-bag for any number up to 100 dollars. On 8 December 1926 I drew 1,250 dollars to pay off the balance owing to the big caravan; I and one of my *zabanyas* counted them in the Bank first, then he could scarcely carry the sack. Once we hired porters, natives of the Guraghé country, who then did all porterage in Addis Ababa, to transport sacks of money under escort of two *zabanyas* with rifles.

Some silver dollars and half-dollars of the handsome coinage struck for the Emperor Menelik, showing his head wearing the triple crown of Ethiopia, were also in circulation. Small change, needed before going into the country, was only obtainable in quantity from the Imperial Treasury, not without delay. But we did eventually exchange 100 dollars for the little silver coins called *piastres*, *tamūns* or *guerches*, at the legal rate of 16 to the dollar (one *tamūn* being worth about 1½*d.*). However, in the country the peasants never granted the full rate, but only eight to ten *tamūns per* dollar, according to the district. Hence the importance of being provided with change beforehand. Small copper coins, worth respectively a half- or quarter-*tamūn*, were distinguished as 'black piastres' from the silver 'white piastres'. All these small coins bore the effigy of Menelik.

In 1948 this coinage had vanished. The Ethiopian dollar had been stabilized at two shillings. Paper bills down to one dollar were current, but the largest coins seen were half-dollar pieces (bearing the present Emperor's head, not crowned) slightly larger than our shillings, and universally called 'shilling', whatever language the speaker was using. I carried supplies of these shillings in sacks. But the peasants still reckoned in Maria-Theresa dollars, which they insisted were worth three shillings; so at first I was often called on to produce half as many shillings more than the number legally required to meet any charge in dollars.

Small change had also to be carried, little copper pieces of ten and five 'cents' respectively (the former worth nearly 2½*d.*). Here lay another snag. West of the lakes, in Wolāmo and Gamo, the people at country markets and elsewhere would only accept ten-cent pieces, which were unobtainable in quantity before leaving Addis Ababa, and of which it was difficult throughout to get enough. But east of the lakes the peasants preferred the smaller five-cent pieces, of which I had procured 2,000 (£10 worth) before leaving the capital—only to find that, as I had to cut short my stay in Sidāmo, they were scarcely needed, though I had been burdened with them during weeks of mule-trekking.

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* It no longer exists, having been superseded by the State Bank of Ethiopia, housed in a more modern building. In 1948 I found the old Bank building in use as the Imperial Treasury.

NARRATIVE: DESCRIPTION OF THE COUNTRY, WITH NATURAL HISTORY NOTES.

ADDIS ABABA (20 *August to* 14 *October*).

Though little entomological collecting could be done during the eight weeks before my departure to the south, yet the scene of this delay merits a brief account. In its swiftly changing phases the character of the capital is hard to delineate. The city stands mainly on the tops and steep slopes of several ridges extending southwards from the 10,000-feet Entotto range. Between these ridges it is intersected by deep valleys or even ravines in which small rivers, swollen during the rains to turbid rushing torrents, flow south to join the Akaki, a tributary of the Hawash. In altitude it varies from about 7,800 feet near the railway-station on the south, to nearly 8,100 feet at the Hôtel d'Itégué (former Imperial Hôtel) and somewhat greater heights to the north, near the foot of the Entotto range.

Though its population was reckoned in 1938 at no more than 90,000, Addis Ababa comprises diverse communities such as the Greek and Armenian, besides the native Ethiopian. Its residents also include Arabs and Indians, nationals of many European countries, of the United States and probably of all English-speaking lands. In its present transitional state, its buildings are of every type, from groups of native tukuls and shanties to modern business houses. Old tracks and country lanes, rough, stony (in the Rains very miry) intersect the older residential quarters between broad modern streets; and peasants drive herds of cattle and goats to market along the pavements to avoid the motor traffic. If ancient San'a, my centre for two months during the Expedition to South-West Arabia in 1937–8, is the 'city of alabaster', Addis Ababa is 'the city of corrugated iron'. Buildings of intermediate grades, between the surviving thatched tukuls and the most modern edifices, are roofed with that material, now much used also in provincial centres.

The more closely built quarters can hardly be called tranquil. Countless dogs bark the whole night through. If a temporary lull occurs at a particular spot, the howling of a hyena will set the dogs off again, while captive lions, kept at the Imperial Palace as living emblems of the Ethiopian Empire, contribute an occasional roar to the din. At dawn commences the whining chant of beggars, asking alms in the name of *Madani Alam* (the Saviour of the World), a sound later drowned in the noise of traffic.

As Addis Ababa occupies a large area, very unequally populated, long distances separate its several parts; for instance, the British Embassy is more than five miles from the railway and still farther from the air-port. Hence also there remain, even near the centre, unbuilt spaces more or less covered with eucalyptus trees, larger groves of which, on the outskirts, embower the city. Beneath this canopy of Australian foliage is spread a carpet of native African grasses dotted with powder-blue *Cyanotis* and other flowers; or in the short turf in open spaces, where the gum trees are farther apart, as on the slopes beside the road leading up to Entotto, patches of native trefoils, with heads of small mauve or purple flowers (*Trifolium petitianum, T. simense*). A small *Kniphofia* (*K. comosa*) with flowers entirely yellow was still blooming in early September; but other species of 'red-hot poker', seen on the high mountains, October to December, had ceased flowering, excepting here and there a solitary belated spike.

Of the eucalyptus trees the most common, and doubtless the first to have been imported, is the Tasmanian Blue Gum (*Eucalyptus globulus*), locally called *yabahr zaf*, literally 'the tree of the sea', meaning 'the foreign tree'. But other species have been introduced mainly on account of their timber being more resistant to the attacks of termites. Though I did not collect specimens, Mr. Glen Russ of the United States Embassy in Addis Ababa, who formerly travelled about Ethiopia on forestry matters, has told me (through the Rev. A. F. Matthew) that *E. rostrata*, Red Gum, and *E. melliodora*, Sweet Gum, besides others which he could not recall off-hand, are growing in Ethiopia. As I have mentioned below (p. 128), the eucalyptus trees at Sōddu in Wolāmo are probably Red Gums.

In September and early October every open space in the capital and the surrounding country is aflame with golden *maskal* flowers, so named from their abundance at the Holy-Cross Festival and their use in certain of its ceremonies; principally the taller larger *Coreopsis prestinariaeformis* (with an orange mark, shaped like a butterfly with outspread wings, on each yellow ray), and a smaller lower *Coreopsis* (probably *C. negriana*). Though the larger has been quoted as the *maskal*-flower, my personal servant (Ghidello Woldesayek, a townsman) insisted that it is called *medj*, and that the smaller species is the real *ababa maskal*; but these vernacular names may be applied to different species by different people. Other yellow Compositae also brighten waste places at this season.

Bunches of the beautiful *Delphinium wellbyi* were brought into the city for sale in mid-September. The plant, as I saw it on this journey, is usually only about 18 inches to two feet high; its large flowers on separate stalks several inches long are rather light blue suffused with pale purple; the petals above the stamens are darker, even deep violet; the very long spur curves upwards (Pl. 3). Its popularity may be partly due to the association of blue with the Christian faith (for example, lay people use blue cord to suspend silver crosses round the neck). I have found these delphiniums flowering as late as November in the mountain-forests up to at least 9,000 feet, also in open spaces, for instance among low scrub on Mt. Damōta.

Of the many flowers to be seen outside the town but within easy reach, some only bloom early in the Rains, or at any rate cease before the dry season. Among the latter was *Craterostigma pumilum* (Pl. 3), raising its white flowers marked with red-purple or violet about two inches from the ground, near a river ten miles north, while the Rains were still at their height (25 August 1948).

The rapidly spreading weed, *Galinsoga parviflora*, native of tropical America, has reached Ethiopia, but I collected specimens only in the hôtel compound.

Garden flowers: the above are a very few selected examples of wild flowers occurring in or near Addis Ababa, though many more could be mentioned. The following lists of cultivated flowers may seem disproportionately long, but I am trying to convey the impression of apparent mingling of seasons and regions made by English garden-flowers proper to all seasons from late spring to early autumn flowering at the same time, together with others not hardy in England; also the impression made by native African birds and insects visiting homely-looking flowers. On both my visits I have been much struck by these things, however commonplace they be to European residents.

In gardens at Addis Ababa in August and September the following, among many others, were blooming together: polyanthus, stocks, lupins, iris, pinks, hollyhocks, geraniums, roses, French and African marigolds, *Tritonia* (montbretia), *Salvia splendens* and chrysanthemums. But during the heavy rains some, notably the chrysanthemums, look very draggled. Other garden-plants flowering at the same time but not hardy in England include bougainvillea, red cannas, white arum lilies in great luxuriance, and a small tree with golden-yellow flowers, native of South America, *Cassia tomentosa*. In the height of the dry season, garden verbenas, geraniums and others still brighten irrigated spots.

Sunbirds and typically African butterflies, such as a translucent-winged *Acraea* (*A. encedon* form *necoda*), may be seen visiting English-looking flower beds. These sunbirds or honeysuckers (a form of *Nectarinia famosa*, the Abyssinian Malachite Sunbird) seen in gardens at Addis Ababa are rather large and dark, with metallic blue-green plumage on their throats, which flashes as they turn on the wing. Other species occur on the East African mountains, where one at least rifles the flowers of giant lobelias (Jeannel, 1950 *a*, p. 235). But I have not seen sunbirds at the higher altitudes on the mountains of southern Ethiopia (*infra*, p. 152).

With these Addis Ababa gardens may be compared that of the British Consulate outside the walls of Harar, at a lower altitude (somewhat above 6,000 feet) and consequently in a less rigorous climate; moreover, in cloudless dry-season weather, as I saw it in January 1927. The house (rented from the Imperial family, and previously the present Emperor's home during his boyhood, when his father, Ras Makonnen, was Governor of Harar) was a building of neither Ethiopian nor British construction. Three-storeyed and narrow-fronted, but rather deep, its staircases were outside the walls. A roofed balcony extending round three sides of the first floor was supported on posts, up which climbed a passion-flower creeper bearing edible fruit*.

The garden displayed a fascinating mixture of English and exotic features. Like many English gardens its rather small space was enclosed by high walls, and had lawns and banks, not of close English turf but at any rate of short green grass. The flower-beds were bright with roses, geraniums, Canterbury bells, *Coreopsis*, *Cosmos*, cornflowers, *Nigella*, antirrhinums, valerian (*Centranthus*), pansies, violets (large and sweet, requiring shade), verbenas, marigolds, zinnias, gaillardias, blue iris, balsams, columbines, candytuft, *Ageratum* and chrysanthemums—all flowering at once. Running water, fringed by maiden-hair fern, was an added charm. But tropical and subtropical plants were there too, large Peruvian Mastic trees (*Schinus molle*) casting shade (and hung with the swinging nests of native yellow weaver-birds, *Ploceus baglafecht*), orange- and banana-trees, bougainvillea, *Plumbago*, scarlet and yellow cannas, scarlet hibiscus, scarlet salvias, oleanders and a morning-glory (*Ipomoea*) with almost sky-blue bells, while pretty little crimson- and orange-flowered *Mirabilis*, called 'four-o'clocks' in the West Indies and elsewhere, grew almost as weeds. A large walled vegetable garden presented a like mixture, cabbages, onions, carrots and strawberries side by side with loquat trees, sweet potatoes, papaw trees (*Carica papaya*), egg-fruit (*Solanum melongena*) and tree-tomatoes (*Cyphomandra betacea*).

This is not a too highly coloured description of the garden remembered in retrospect long afterwards. I indeed retain a vivid impression of my stay there, but could not rely on memory for the lists of plants and other details, fully noted in my journal at the time.

The insects too, especially the butterflies seen at and near Harar, were geographically mingled. Strangely exotic-looking flies of the genus *Diopsis* (typical genus of a family inhabiting the Oriental Region, and tropical and South Africa), in which the head is T-shaped, produced into lateral stalks each bearing one of the compound eyes, were settled on homely English garden flowers.

Beginnings of flower-gardening now (1948) seen outside some Ethiopian buildings in quite remote places are noted on p. 154.

As intimated by my allusion to the 'less rigorous' climate of Harar, I have on both journeys found the climate of the capital rather grim—too chilly and stormy (with frequent thunder and hail), too often sunless and raw, in the Rains; too windy and dusty, sometimes for long spells, in the otherwise pleasant Dry Season. Some (not all) foreign residents will agree with this opinion. As far as I can judge from my two visits to Ethiopia, places at altitudes considerably lower, yet not low enough to be uncomfortably hot, have the most agreeable climates ; i.e. between 6,000 and 7,000 feet, for example Harar and Shashamanna, both over 6,000, or Sōddu (Wolāmo), about 6,800 feet.

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* The old house at Harar described above no longer serves as the British Consulate.

Menelik, after abandoning Ankober, the old capital of the Shoan kingdom, resided for a time at Entotto, at the top of the range, where the climate is even more rigorous than at Addis Ababa. Perhaps partly for that reason, after his victory at Aduwa in 1896 the Emperor chose as the nucleus of his new Imperial capital the small town founded by him several years earlier at the foot of the hills. The site had the advantage of being at the centre of his vast realm, but for climate and other amenities he might have descended rather lower to plant his ' New Flower '.

Though regular entomological work was impossible, yet interesting finds can still be made in the capital. I first searched for small subterranean beetles in a vacant space among eucalyptus trees in the lower part of Addis Ababa, under the guidance of Dr. Giaquinto-Mira. Levering up large deep-sunk boulders of igneous rock, we collected from the soil underneath minute species of Scydmaenidae, Staphylinidae, Anthicidae, and especially a tiny Carabid (*Polyderis brevicornis*) of immensely wide distribution in the Mediterranean region, and in East and South Africa (Jeannel, 1950 *b*, p. 183).

ADDIS ABABA TO SŌDDU (WOLĀMO) (15 *to* 21 *October*).

In this journey of some 230 miles several distinct kinds of country are traversed. As each typifies large parts of high Ethiopia, and as the transition from one type to another is usually abrupt, it seems best to take the sections in order.

From the capital to the Hawash River : this first 60 miles lay over the only metalled road traversed in the whole journey, the first 42 miles of it lying close beside the railway. The hills, mostly rounded in outline, and the plains of this part of Shoa are largely treeless, except where clumps of eucalyptus surround houses and churches. While the Rains are at their height, black mud is too abundant and the landscape, despite its verdure and the wealth of flowers, is at times depressingly bleak. In the Dry Season, on the other hand, the stubbles (for there is much valuable agricultural land hereabouts) are parched and dusty.

Mount Zuquāla rises to the south, but I have elsewhere (1950, pp. 158–9) recorded impressions of my stay in 1926 on the edge of its heath and juniper-covered crater, overlooking its sacred lake. Professor Omer-Cooper also briefly described this crater, likewise the five crater-lakes of ADDAS, north of the road (1927 *a*, pp. 381, 385 and *b* ; 1930, pp. 203–4). The best known of these strongly alkaline waters, Lake Bishoftu, now has a hotel above its southern shore, used by residents in the capital for day-excursions and holidays.

Turning south from Modjo the road descends more than 800 feet in less than 20 miles to the bridge over the Hawash. Beyond this the roughly 170 miles remaining to Sōddu lay over earthern or rocky tracks.

The Hawash to Neghellé : (Neghellé, just south-east of Lake Shala, must not be confused with Neghelli, a more important place some 160 miles south-east, on the route from Wondo to Mogadishu). Between the Hawash and Makki Rivers (Pl. 4), and beyond the latter along the west side of Lake Zwai and farther, the country at a little over 5,000 feet is covered with bush of varying density, on entering which the transition to dry grass and acacia scrub is sudden.

Birds and beasts : as my lorry traversed (16 October) thin bush I had fleeting glimpses of gorgeous yellow-and-red climbing lilies (*Gloriosa*), and was impressed anew by the teeming bird-life of this bush-country of the middle altitudes. Though not an ornithologist I had taken careful enough notes in 1926 to get (with kind help from the late W. L. Sclater and others) reliable identifications of a fair number of birds. I now renewed acquaintance with some of these, such as the peacock-blue Spreo-starling (*Spreo superbus*), a bush-shrike (*Lanius collaris*), Dinemel's White-headed Weaver (*Dinemellia dinemelli*), the Waxbill (*Estrilda troglodytes*) and many others—the Hoopoe, the Red-billed Hornbill, chats, wheatears, rollers, honeysuckers, pigeons and doves of several species, besides hawks, vultures and numerous flocks of wild guinea-fowl, up to 15 in a flock. A few further bird-notes, and remarks on the vexed question of their nesting-seasons, are given below (p. 146).

Only once during the recent journey did I see the most extraordinary of Ethiopian birds, the great Ground Hornbill (*Bucorvus abyssinicus*), some four of which were waddling solemnly over open fields near Modjo (28 January 1949). In 1926, opportunities were more frequent. On 3 December in that year, I noted that my (then) personal servant, a quadri-lingual man named Tagagne, chased a pair of these birds (also near Modjo) for no other reason than to laugh at their slow solemn gait and short lumbering flight. Probably they are not really scarcer than formerly, for I doubt if people hurt the *abbagumba*. Blanford (1870, p. 330) remarked that ' to anyone accustomed to the Hornbills of India . . . . it is as startling to see one of the family stalking over . . . . an open plain, as it would be to find plovers feeding in trees '.

As to wild beasts, there is not (and was not) anything comparable with the abundance of ' big game ' in East Africa. A leisurely cheetah crossed the track in the acacia-bush south of the Hawash. Jackals were often seen by day and heard at night. Hyenas, audible on many nights, rarely showed themselves. I have told below how I watched a serval in the high country near Chencha (p. 141), and what I saw during the long night-journeys through the dry southern bush (p. 158). Mole-rats and ground-squirrels also figure later in this narrative (pp. 147, 162).

But taking the journey as a whole, such animals as Chacma and Gelada baboons (*jinjero*), *Cercopithecus*-monkeys (*tota*)*, hyrax (*Procavia*, seen in 1927 on a rocky hill close to Harar city) and several species of antelope, were either not seen at all or much less often than in 1926–7. This may be partly accounted for by the different nature of the country visited, but also by the diminution of wild animals during the War of Liberation and the rather chaotic period immediately following. The game-reserves planned during the Italian régime have not (as far as I know) materialized (see postscript, p. 188).

This time I had not even a glimpse of the beautiful *guerèza* (*Colobus guereza*), the graceful monkey whose dorsal mantle of long black and white hair is unhappily much in demand by hunters. Yet in 1926 we saw (and heard, by the shaking of the branches) these monkeys leaping and climbing in the loftiest *Podocarpus*-trees, and once I had a long look at a little group, including a mother clasping her infant, high in some tall junipers. For the *guerèza*, though so delicate as to diet that it can scarcely be kept in captivity, endures the climate in the conifer-forests up to nearly 10,000 feet ; while, if what I was told of its abundance at Harar (6,000 feet) is correct, it must have a considerable range in altitude. I did not hear of the belief which, according to Griaule (1934, p. 6), is held in some parts of the country, that the *guerèza*, unlike the *jinjero* (baboon), has a soul ; consequently the wanton shooting of *guerèzas* (by European sportsmen) was disapproved, ill effects being feared as a result of violently setting their souls free from their bodies.

Arussi tribesmen : pagan Arussi Galla, living largely on milk, inhabit this stretch of bush-country. Men and boys with little clothing, the older ones carrying spears and usually also several sticks, watch over immense herds of cattle and goats, difficult to photograph (Pl. 4) as they constantly shift their position among the small acacia trees. When travelling (October–November 1926) from the Hawash to Lake Zwai on horseback, I passed herds of cattle over a mile long, and watched a herd driven to water in the Makki by two Arussi boys who meanwhile enjoyed a swim ; one swam strongly with a double over-arm (trudgen) stroke, the other, a poorer swimmer, used a breast-stroke and often clung to a cable-like creeper hanging from the bank.

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* Regarding the particular species and subspecies of monkeys (*Cercopithecus* and *Colobus*) met with, see p. 105.

The Arussi are of slight but strong physique. Like the Borāna Galla seen later (p. 161), they have handsome features. Their women, like the Borāna, wear numerous necklaces and heavy bracelets, but those inhabiting the slopes of Chillālo, who visited my camp in the high forest-zone in 1926, were scantily clad in rags and skins, despite the cold. The Arussi seemed more shy of the camera than the Borāna, but I got interesting photographs of their wayside monuments and trophies, described in Appendix A (pp. 172–3 and Pls. 27, 28 ; see also Omer-Cooper, 1929).

At the village of *Adamitullo*, south-west of Lake Zwai, a crag rising abruptly from the bush-covered plain is crowned by massive stone ruins, resembling at first sight medieval remains, but really the fragments of a large house built by a German settler who came here more than 40 years ago as a cattle-breeder and ostrich-farmer. His ostriches were dispersed or killed and their feathers taken for personal adornment by Arussi tribesmen in a raid. His house was destroyed and he and his daughter took refuge on an island (an abode of monks) in the lake. But he was still living at Adamitullo, in a small house at the foot of the crag, in 1948. His late wife was Ethiopian, which accounted for his daughter, a lady quite Ethiopian in looks and dress, addressing me in German, to my astonishment, in the village street. Her father, to whom she took me, seemed to have been little affected by the second World War. Apparently a greater event in his life had been the visit of Omer-Cooper in 1926.

Spread of Opuntia : imported prickly-pear was plentiful on the crag at Adamitullo among the native *quolquol*-trees (*Euphorbia*). During the train-journey from Djibouti to Addis Ababa I had noted the abundance of *Opuntia* near the town of Diré Dawa, where I could recall seeing little or none in 1926. It is to be hoped that Ethiopia will never be confronted by a prickly-pear problem like that which has afflicted Australia.

South of the Suksuki River (flowing from Hora Abjata into Lake Zwai), the route traverses the narrow isthmus between Hora Abjata and Lake Langana, but thick bush allows scarcely a tantalizing glimpse of these lakes or of Hora Shala (*Hora* signifies a saline lake). Hearing that the road south was blocked by an overturned lorry I spent the night at Neghellé, sharing a small room in a primitive road-house with a heap of potatoes, after the ejection of some fowls. I had travelled over 90 miles from Modjo, but was still 16 miles short of Shashamanna, which we had hoped to reach.

Neghellé to Shashamanna : though these 16 miles occupied all next day (17 October) the country, by its changing character, was interesting. Deep holes full of liquid black mud and standing pools between the ruts caused my Somali chauffeur to make détours through the long coarse grass, hoping that the pressed-down haulms would provide a firmer substratum. But more than once the vehicle had to be dug out of the mud, or hauled out with an alpine rope intended for quite other purposes. My men formed a team, augmented by half-naked Arussi tribesmen on their way to Sunday market at Neghellé. These were at first unwilling but, though pagans, they could not resist a cry for help in the names of the Archangels Gabriel and Michael uttered by my cook, an old Muslim.

Meanwhile I collected small beetles from beneath tussocks of coarse grass, where the track leaves the acacia-bush and rises to about 6,500 feet. In this country of rich black soil the valley-bottoms are boggy, their sides covered with wide expanses of grass-tussocks (*Hyparrhenia hirta*, *Pennisetum schimperi*, *Eragrostis tenuifolia*, etc.), interspersed with patches of tall millet (*Sorghum*, in Amharic *mashilla*, Arabic *dhurra*) and other cultivation, and dotted with large wild-fig trees, thorny *Zizyphus* and huge *quolquols*.

Succulent Euphorbias: the great *quolquol* or candelabra-trees are one of the most striking components of Ethiopian scenery. Since the earlier journey (1926–7) the euphorbias from the dead parts of which I collected insects in Jem-Jem Forest, 8,900–9,000 feet, have been referred to in papers (and on labels attached to insects) as 'Euphorbia abyssinica', but I have recently learned from Mr. Peter Bally that two species are involved; *E. candelabrum*, which has no ordinary leaves at the ends of the branches, found at altitudes from 3,000 to about 6,000 feet; and *E. obovalifolia*, with clusters of obovate ordinary leaves at the ends of the young branches, thriving between about 6,000 and 9,000 feet. The great *quolquols* in the background in Pl. 5 are *E. candelabrum*. But at Sōddu (6,800 feet) and thence as far south as the southern slopes of the Gughé Highlands many examples of *E. obovalifolia* occur; they are usually smaller and less compact and massive than *E. candelabrum* and grow in dense forest where any remains (the *quolquols* in Jem-Jem Forest, 1926, were almost certainly *E. obovalifolia*) or are planted in the open as hedges, but always at high altitudes. Besides the difference in foliage the two species also differ in the size and shape of their red fruits. But though the little yellow flowers of both were blooming during my journey, I never found ripe fruits.

A third succulent euphorbia of the highlands, the *tirucalli*-tree (*E. tirucalli*), with slender smooth green branches and compact groups of yellow flowers at their tips, was only met with (on this expedition) much farther south (p. 137).

Changes in vegetation: small, delicate, rather light blue lobelias (*L. anceps*) appeared in the short grass at Shashamanna. Thereafter, at Sōddu and on Mt. Damōta, at Chencha and in the eastern approaches to the Gughé massif, between 6,000 and nearly 9,000 feet, other beautiful little lobelias were common (*Monopsis stellarioides* on Damōta; the others possibly *Lobelia scebelii*, but not identified with certainty). In some places their growth is very spreading but, where sheep and goats browse, they are very compact, and closely speckle the short green turf with bright blue.

The deep pink flowers of low herbaceous species of *Oldenlandia* (Rubiaceae) also brightened the grass-land at Shashamanna. These flowers reappeared on the lower slopes of Mt. Damōta and again on the rather dry lower hills south of the Gughé massif (p. 155).

Certain plants common in almost every part of the Ethiopian highlands visited on my earlier journey were scarcely, or not at all, met with on this southern trek. It seemed strange to be without the white wild rose (*Rosa abyssinica*), never out of flower during the last month of the Rains and the following months in 1926–7, at 8,000 feet and higher, but I did not see it in the southern provinces. On the other hand, brambles (*Rubus* sp.) abounded in the heart of the Gughé Highlands, in some places mixed with thoroughly tropical vegetation; but though they were always gay with long clusters of flowers, pale pink to deep purple-pink, only very rarely was a cluster of red (not black) fruit seen, e.g. 5 and 30 December.

Shashamanna to Sōddu: on this latter part of the journey mud was not the chief obstacle, but bare rock, over which the vehicle jolted heavily, causing a few breakages in our kit, while I held my camera pressed to my side for hours to minimize the jarring.

The route turns west and between 30 and 40 miles from Shashamanna an exceptionally large acacia (Pl. 5) marks the boundary between Arussi and Kambāta Provinces. This noble tree stands among bush of small thorny acacias, some of which then (19 October) bore yellow, others white, fluffy clusters of flowers.

Alāba: beyond the frontier-tree the bush gives place to the richly cultivated plain of Alāba. The town (which I have called simply 'Alāba', as my men apparently did, though the market is called Gulito in the *Guida*,

p. 557, and is marked Colito on the International Map) is a collection of skep-like grass-thatched huts, boasting a dilapidated-looking mosque and a very large market-place, in the middle of which a small daily market was in progress round a single tree. Its people dress as ordinary Ethiopians, but some country-women present wore a special kind of grey shawl with a fringe.

Segregated populations: among several distinct peoples in Kambāta Province, these plain-dwellers, the Alāba, largely Muslim, have been regarded as partly of Arab blood (A. & C., p. 275). The Kambāta proper, living principally in the mountains and speaking their own tongue, are one of the many components of the vast racial aggregate known as SIDĀMA (a much larger group than the people of SIDĀMO Province, east of the lakes).

The Sidāma, who include the people of Wolāmo (Pl. 8), Borodda and Gamo (many times mentioned below) are classed as 'high Cushites', distinct from their traditional adversaries the Galla, another widespread Cushite (Hamitic) group (*Guida*, pp. 80–3). According to M. Marcel Cohen (A. & C., p. 213, footnote), the Sidāma, who were so named by the Galla, had been influenced by the Christian and partly Semitic culture of northern Ethiopia before their pagan conquerors, the Galla, arrived.

Azaïs and Chambard (p. 275) mention the occurrence in Kambāta of people with slit-like eyes (*yeux bridés*) and features and complexion resembling those of Chinese. Several times on my journey I independently noted apparently Mongolian types (p. 161), though those whom I saw had a much darker complexion than most Chinese and, of course, frizzy hair.

The close segregation of peoples of different races and languages rendered necessary the employment of Amharic-speaking guides in Wolāmo and Gamo. The Wolāmo language, spoken throughout these two provinces, was unknown to my men from the capital, though they had travelled much and all spoke both Amharic and Galla (several of them also French, Italian and Arabic). They were equally at a loss among the Nilotic Negroes of Ghidolé and Konso, but as soon as we reached Yavello, among the Borāna, they could converse freely again, in the Galla (Oromo) tongue.

Alāba–Shoné–Sōddu: resuming after the digression necessary to make what follows intelligible. South-west of Alāba town the track twice descends slopes of bare rock to fords across the Berberi–Billaté river-system, flowing south among bush to Lake Abaya, then emerges on to the grassy, tree-dotted plain of Shoné.

A long and high green mountain with several summits and much cultivation on its slopes would have tempted me to diverge north-east of the road. But to visit it was forbidden, as places in Kambāta were not specifically mentioned in my Ethiopian Government Passport. This mountain is named Amberichio, but on some maps (e.g. *Guida*, p. 552) the name appears at least twice in the same province; a comprehensible repetition if, as Hodson (1927, p. 26) avers, 'ambericho' is simply the Kambāta word for mountain.

I halted for a day (20 October) on Shoné plain outside the village of Bulghīta (about 6,200 feet). Here, in partial retirement, resides Ras Gyetāchu, a middle-aged gentleman with courtly manners, speaking excellent French, like many chiefs of his generation. His son, Lij Abāta, showed me a reservoir (Pl. 7) artificially constructed by damming a shallow valley, but without masonry. This, the only water-supply of Bulghīta, dates (I was told) from the time of Ras Gyetāchu's father, the late Ras Abāta (founder of the town of Hosanna, capital of Kambāta)*. Ras Gyetāchu remarked on the lack of water in the vicinity. But, apart from the modern water-supply of Addis Ababa, Bulghīta is the only place where storage of water is necessary which I have seen in high Ethiopia. With the more copious rainfall and almost countless rivers, the ancient inhabitants had no need to construct in the highlands great masonry-lined cisterns like those so numerous on the high table-lands of the Yemen.

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* The statement that Ras Abāta founded Hosanna is taken from Azaïs et Chambard, in whose narrative (p. 274) the present Ras Gyetāchu figures as 'Dedjazmatch Guietatchaw'. (I have recently heard of the Ras's death).

The camping ground was typical of many halting-places of *nagadis*; a single large wild-fig tree beside the road, surrounded by coarse herbage of thorny *Solanum* (*S. indicum*), a plant of the mallow-family (*Pavonia urens*) and other weeds. Such sites are to be avoided when possible. They are filthy and swarm with flies during the hot hours, while at Bulghīta the open, tussock-covered plain was swept at night by a cold east wind. But such places are frequented by certain attractively coloured, widely-distributed Vanessid butterflies (*Precis oenone*, *P. chorimene*, *P. octavia*; in like places also (1926) the dark-brown and yellow *Eurytela dryope*, presenting a striking appearance in flight).

Sōddu was reached on 21 October, after a drive of some 25 miles. Beyond the little town of Boditti the stony track was bordered by banks of mauve *Solanum*, yellow Compositae, and scarlet acanthus (this last was seen again south of Sōddu, but identification has not proved possible, though pink-flowered and blue-flowered species of acanthus have been identified, see pp. 136, 155, 157). Finally, the track leads up and down over the spurs of Mt. Damōta and the small rocky-sided intervening valleys, then curves and descends southwards to the town.

SŌDDU, CAPITAL OF WOLĀMO PROVINCE (21 *October*–16 *November*).

Sōddu town and surroundings; *crops, industries, etc.*: the provincial capital of Wolāmo lies at about 6,800 feet above sea-level, under the southern slopes of Damōta. Broad almost flat-topped promontories of the mountain extend far southward into the plain. The large station of the Sudan Interior Mission, in the hospitable compound of which I camped, stands on one of these promontories, some three miles east of the town. (Sōddu in Wolāmo, sometimes spelt Soddo, must not be confused with Soddo district in Guraghé, about 120 miles north; both names may be derived from the same root, see p. 169, footnote.)

From a distance the rather nondescript buildings of Sōddu, including some erected under the Italian régime, are largely hidden by eucalyptus trees. These are smaller and younger than the oldest of the Blue Gums at Addis Ababa, and I was told that they are of a different species (probably the Red Gum, see p. 121), having timber more resistant to insect-attack.

West of the town yet another promontory, known as 'Menelik's Hill', proved a good collecting-ground for insects characteristic of an altitude below 7,000 feet. Here also stand two pairs of ancient phallic monoliths, their meaning is apparently forgotten, but a little thatched church probably attests the sanctity still attributed to the spot in more recent times. Such monoliths are very numerous in these southern provinces. Further description of those which I saw and a brief discussion of the views of archaeologists on their origin will be found in Appendix A (pp. 171–2 and Pls. 26, 27).

After the bleak landscapes of central Shoa, and the monotony of the acacia-bush, the immediate surroundings of Sōddu looked very beautiful. The close cultivation, the hedges of euphorbia round enclosures near the town, and the plantations of *enseté*-trees (*Ensete edulis*), with the hot bright sunshine glinting from their burnished leaves in the crystal-clear atmosphere between the October thunderstorms, all contributed to an impression of richness and fertility. I, who had never seen any such countryside in Ethiopia, felt much nearer to what I had heard of central Africa.

Every man and woman met in the country uttered the friendly Wolāmo greeting *saro*; usually twice, *saro, saro*, then a pause followed by three more *saros*, while some people, after another pause, uttered a whole volley of *saros*. *Saro* sounds not unlike our 'hullo' and serves the same purpose.

Crops: certain crops first seen at Shoné were abundant round Sōddu and further south. In October the fields formed little patches of contrasting hues, yellow, various shades of green, red where the bare soil was exposed, and lavender-blue. This last colour was due to the salvia-like flowers of *Coleus edulis*, the ' Galla potato ' (*dinecha oromo* in Amharic, *walaita donnua* in Wolāmo). The plants, grown in rows, are earthed up like potato-plants. The starchy tubers on their long underground root-runners (thought by Europeans to lack distinctive flavour) were said to be at their best at Sōddu in January; but farther south, at Ezo (about 9,000 feet), I saw people digging them with mattocks in late November (Pl. 9).

The many fields of large-leaved aroids here called *godari* (*taro* or *coco* in other lands; *Colocasia antiquorum*) evidently cause concern to their owners. They are usually protected by erections such as tall poles stripped of their bark in alternate bands, surmounted by inverted *gombos* (earthenware vessels), skulls of cattle, rags and pieces of hide (much as in the trophies of dead Arussi warriors described on pp. 172–3, only with slender sticks rather than trunks and limbs of trees). But I could not clearly learn whether these objects in the *godari*-fields are simple warnings to passers-by, or more occult defences against witchcraft. In some cases the well-known pulse called in Ethiopia *shimbera* (*Cicer arietinum*, the chick-pea) was grown in the same field with the *godari*.

The cereals naturally included the grass *teff* (*Eragrostis tef*), the flour of which is so widely used in making thin moist sheets of bread (*injera*).

In a garden at the Mission Station the purple-flowered ' pear-melon ' bush (*Solanum muricatum*, native of Peru) was cultivated in quantity. At Addis Ababa its fruits (long-ovoid, pale yellow with dark stripes) had seemed to me insipid, but the missionaries at Sōddu found them refreshing during their long fatiguing tours in the hot lower country. Few people were aware of the plant's identity; some called it ' melongena ', confusing it with the aubergine (*Solanum melongena*), others termed the pear-melon ' Italian apple ', ascribing its introduction to the Italians.

Fortunately for me some pieces of ground remained uncultivated and bright with flowers. The Mission Station fields were edged with wild ' borders ' of an *Ageratum* (*A. conyzoides*), with flower-heads of palest lilac. A path led down to a stream through tussocks of tall grasses (*Panicum glabrescens, Hyparrhenia phyllopoda, Sporobolus phyllotrichus*) among which stood out, here and there, crimson-headed globe-thistles (*Echinops amplexicaulis*) about four feet high, striking, but less spectacular than the gigantic *Echinops ellenbeckii* of Mt. Chillālo (Scott, 1950, p. 162, pl. xxxv). In patches of scrub grew a wild hibiscus-bush (*H. macranthus*), the white blossoms of which, marked inside with purple, turn wholly mauve when fading. Patches of short turf were almost blue with small lobelias (probably *Monopsis stellarioides*; see p. 126).

Bee-keeping: local bee-keepers seemed to favour the practice of putting conical thatch-covered hives singly in trees, as in the *Dracaena*-tree shown in Pl. 23, while elsewhere, as far south as Konso, longer hives, shaped more like elongated barrels, are also placed singly high up in tall forest-trees . This is probably the method most usual in the country as a whole; only once, near the bridge over the Makki, did I see a battery of barrel-shaped hives on a low wooden platform (Pl. 7), an arrangement recalling that used in South-West Arabia (Scott, 1942, phot. 31) but less common in Ethiopia.

I have not tasted local honey, but have often sampled the national beverage, *tej* (mead), which varies locally in flavour and potency.

Brewing: though *talla* (beer) was also plentiful, I do not remember on this journey seeing *gesho*, the erect bush (*Rhamnus prinoides*) the leaves of which are used to give the beer its bitter flavour. On my earlier journey I met with this plant, related to buckthorn, only in the sacred monastic precincts on Mt. Zuquāla and at Debra Libanos. I was shown over the great brew-house of the latter monastery.

Bamboo ; house-construction and other uses : bamboo does not grow, at any rate in quantity, quite close to Sōddu, but on Mt. Damōta, up to over 9,000 feet, the bamboo-zone (pp. 91–4) is well represented, though confined to woods limited by human agency. Bamboo, among its numerous local uses, enters largely into the construction of the skep-like grass-thatched houses (Pl. 6). These are the ordinary type from Shoné onwards through Wolāmo and Gamo Provinces, and (though equally prevalent in large parts of Sidāmo) are spoken of as *Wolāmo bēt.* They are quite distinct from *Amhara bēt,* the circular *tukuls* like those of central Abyssinia, having perpendicular walls of laths with the eaves of the conical thatched roof widely overhanging. Houses of this latter kind are only seen in some quarters of the outskirts of Sōddu where Amharic-speaking immigrants from the north live.

Viewed from inside, the plaited structure and concentric rings of the roof-framework and walls of the beehive-like Wolāmo houses appear wonderfully intricate and neat. The astonishingly roomy better houses are divided into several apartments by screens of interwoven laths of split bamboo, curved round at the ends so that the inmates, passing to and fro, may not hurt themselves against the sharp-edged ends of the laths. Space is certainly needed, as I realized when a householder, under whose walls I slept *al fresco* on the top of Mt. Damōta, took into his house at night not only his wife and family, but four cows, two ponies, six sheep and some fowls. The cattle and ponies were neatly stalled behind partitions of branches. Everything was in its place. The man's spear stood upright, supported by a looped bamboo lath ; his sickle and tools hung from the upward-slanting projecting ends of other laths. The hearth was in an inner apartment, screened by bamboo partitions. Openings near the ground gave egress through carefully constructed channels to sewage, at any rate from the stable.

The crowding of the family and their domestic animals into the house at night results not only in protection to the beasts, but in raising the temperature in high, cold places. Unfortunately, such houses easily catch fire and also harbour vermin. Not that I suffered from the latter, but requests for insect-powder were frequent, especially on the main route through Sidāmo, by which I returned northwards ; for the country-people no longer always acquiesce in the old uncleanly ways of living.

Wolāmo graves : in contrast to the houses of the living, the Wolāmo people surmount their grave-mounds with flimsy erections looking rather like the partly finished framework of houses, though smaller. Their ' tombs ' could hardly be more different from the grave-stones, trophies and cairns of the Arussi and Kambāta (pp. 172–3 and Pls. 27, 28). The left-hand one of the two ' tombs ' shown (Pl. 6), with a branched stick projecting at the top, was a man's grave ; in the woman's grave, on the right, lay a basket. Hodson (1927, opp. p. 28) shows a Wolāmo grave of this type covered on top with white material and hung with matting ; he states that the pagan Wolāmo formerly buried living persons with the bodies of eminent people.

Bamboo trumpets : a special use of bamboo is illustrated in Pl. 9. The poles, 10 or 12 feet long, are pierced right down with a hot iron while the stems are still young and the partitions soft. They are surmounted by horns of cattle or other animals (the middle instrument in the photograph bore the horn of a wild animal ' no longer found in the district ', possibly a nyala ; the outer two bore cow's horns, unfortunately just outside the field of the photograph). These musicians, summoned to play at a funeral, gave a demonstration by the wayside. Turning their heads sideways and blowing into an opening in the bamboo, they produced a deep rhythmic buzzing sound, accompanied by the drum. Père Azaïs saw similar instruments used at a funeral in Wolāmo (A. & C., p. 271, Pl. 94, fig. 2). But I have learned that instruments of the same kind were recently used at the opening of a church in Addis Ababa, where they are called *imbilta*, while the ordinary shorter trumpet is *malakat*.

The enseté-tree: though plantations of this tree (*Ensete edulis*) are very numerous at high altitudes in these southern provinces, where, in the Gughé mountains, it grows higher up than any crop except barley, I can say less at first hand about its uses. The tree is a very important source of food among the Galla, Sidāma, and Guraghé races. The fruit (containing relatively few and large seeds) is apparently not eaten, but the medulla (pith) of the inflorescence-stalk is cooked and eaten, and a flour is made from the plant. In Gamo I occasionally saw houses thatched with *enseté*-leaves instead of grass, while pieces of the leaf are constantly used (like brown paper in Europe) as wrappings for packets, and the fibre serves for various purposes.

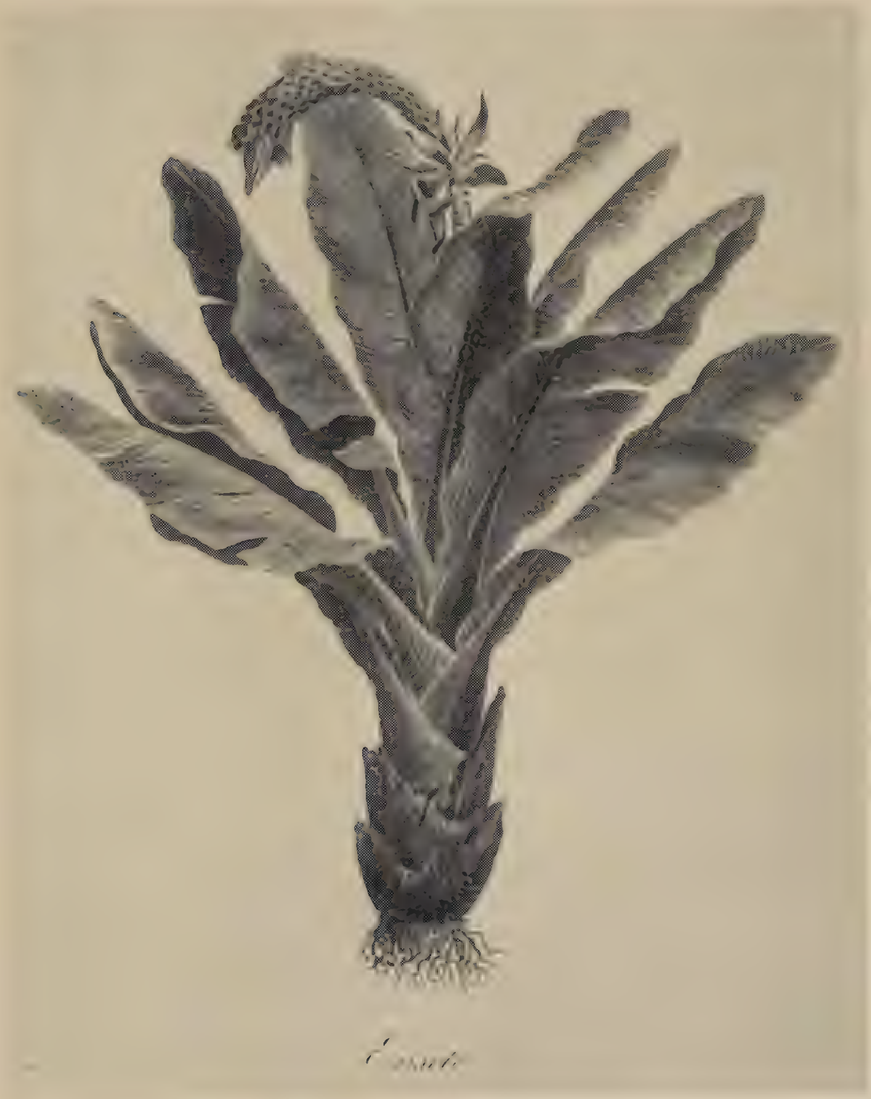

FIG. 5.—The *enseté*-tree (from James Bruce, 1790).

Being impressed by the obvious difference between the inflorescences of the *enseté* and the banana, I was interested to find (since my return) that *Ensete* and *Musa* are now treated as separate genera. Thus has recent taxonomic work vindicated the powers of observation of James Bruce*, who (1790, vol. v, p. 36) clearly described the plant under its vernacular name, and its uses, adding two plates of his drawings. Bruce remarked that 'some who have seen my drawings . . . . have thought the Ensete to be a species of the Musa. . . . This . . . . I imagine, is without any sort of reason'. Nevertheless, in 1791, the *enseté* was referred to the Linnaean genus *Musa* and, although the plant was raised to generic rank in 1862 (by Horaninow), later botanists again merged it in *Musa*. However Cheesman (1948), being convinced on genetical, cytological and taxonomic grounds that the two genera are distinct, has redefined *Ensete*, with Horaninow's *Ensete edulis* as its type-species, and has transferred to the genus a number of species hitherto placed in *Musa*. I believe, though without absolute proof, that most or all the *enseté*-trees which I saw were of the type-species.

The bananas which my men occasionally bought at local markets were short, thick, not much curved and usually very over-ripe. That they were real bananas, not *enseté*-fruit, was shown by their many small seeds. No doubt they were grown in the warmer climate of lower altitudes, but I cannot say exactly where.

Cotton: lastly, cotton plays an important part in the local economy not only at Sōddu but in many parts of Wolāmo and Gamo Provinces. The crop is not grown at a much higher altitude than the lakes (i.e. somewhat above 4,000 feet). The only two places where I saw cotton-plants were (1) in occasional fields of black soil near the lowest part of the route south of Sōddu, between Humbo and Borodda (p. 137) and (2) in the stone-terraced fields at Konso (p. 159). But the cotton itself is brought up to higher levels and spun by the country people at their homes (Pl. 10). The seed is mostly picked out by hand, or this process and the fluffing out of the raw cotton may be completed with hand-tools; the spinning and winding are also done by hand (Rey, 1923, pp. 200, 222–3).

Farther south I met strolling bands of weavers, carrying their folded-up looms slung across their backs. The weavers shown in Pl. 10 had set their looms up in the market-place at Ghidolé, and were gone the next day; yet the man in the foreground was weaving a piece of some width, though often they weave only narrow borders or hems.

The finest cotton fabrics are very light and thin, for example, the finest grades of the *shamma*, the toga-like garment still widely used by both sexes, even when semi-European dress has been adopted. But my men bargained with itinerant vendors at Bonghé for large pieces of a white cotton fabric as thick as a blanket, with which they swathed themselves in our high, cold camp on Mt. Tola, and which they also used as bed coverings. The vendors may have come from Garassé (Gherezzé), south of the Gughé mountains, a place mentioned as a centre for the weaving of these thick fabrics (*Guida*, p. 552). Thick cotton-stuff of a like nature is also woven at Konso, where I saw a man whitening a folded piece by beating powdered pumice-stone into the fabric.

Votive offerings of cotton are frequently made at sacred trees and stones in Wolāmo and Gamo: see Appendix A (p. 173).

Insect-collecting at Sōddu was of a fairly general character, but certain features stand out in memory.

At the Sudan Interior Mission, the wood-work beneath the eaves of some long ranges of stone-walled buildings was so riddled with the large borings of a species of carpenter-bee (*Xylocopa* (*Koptorthosoma*) sp.), that the Rev. T. Simpson (senior member of the Station) was obliged to attempt the destruction of these occasionally harmful insects by driving a poisonous spray into the burrows under pressure. Some sections of the woodwork were so damaged that they had to be removed and replaced with new planking. Mr. Simpson pointed out to me an apparent imperfection in the guiding instincts of the bees: barge-boards about an inch thick projected downwards from the outer edge of the eaves, leaving a space of several inches between them and the thicker timber of the wall-plates along the top of the walls. But the bees had in some cases wasted their energies in boring through the barge-board from the outside, only to emerge in the intervening space and to have to begin boring all over again in the thicker wall-plates; the barge-boards themselves being scarcely thick enough to contain the nests of these large bees.

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* A recent appraisal by E. Boyd of James Bruce of Kinnaird and his work appeared under the title 'Prophet without honour' in *The Scottish Field*, Sept. 1950, pp. 17–19.

Collecting at night: during the late spell (23–27 October) of thunderstorms night-flying insects abounded, as commonly happens in wet weather if not too cold. Though I had not intended night-collecting to be a major activity, I found myself living in an improvised light-trap. The storms were so torrential that, by their kind invitation, I moved from my tent in the Mission Compound into the house of Dr. Nathan J. Barlow and Mrs. Barlow. Their guest-room had white walls, its windows faced west and south, and it was brightly lit by electric light till 9 p.m. I had only to open and shut the windows alternately, capturing the insects which entered each time. Besides beautiful moths of many species, mantises and beetles, the light drew unpleasantly numerous large cylindrical-bodied male driver-ants (*Dorylus helvolus*), or ‘ sausage insects ’ as they are sometimes called. They banged heavily against the window-panes and, when admitted, flew about the room with an irritating rasping buzz. The moths were most numerous on 26 October, when a south wind arose about 6 p.m., shrouding everything in mist, which later turned to drenching rain lasting most of the night (cf. p. 113).

MT. DAMŌTA (28 *October and* 4–6 *November*).

The principal object of my stay at Sōddu was to visit this isolated massif, towering above the surrounding plateaux to over 10,000 feet (Pl. 11).

At my first ascent (28 October) I reached, mainly on mule-back, a high, partly detached spur, connected with the main massif by a lower, narrow, scrub-covered ridge. On the second occasion (4 November) we again rode our mules to a point a little short of this spur. Then, forced by the steepness of the gradient to dismount, we continued on foot along the connecting ridge and up the nearly precipitous southern face of the main massif, pushing our way through scrubby bushes, scrambling over rocks and up steep grassy slopes.

I saw no real mixed forest on the mountain except (during my descent on 6 November) near the foot of the southern slope, on the far side of Sōddu town, several miles west of the Mission. At this point was a richly wooded ravine, the precipitous sides of which were threaded by paths, in places overhanging, and so narrow that it was difficult to pass people coming the opposite way. This forest was not tall but dense and varied. Among other trees stood occasional wild date-palms (probably *Phoenix abyssinica*) 15 to 20 feet high, bearing very small, short, unripe green dates (compare the much greater luxuriance of these palms farther south, pp. 155–6).

During the ascent our too-familiar bracken (*Pteridium aquilinum*) was met with at a relatively low level, not dense, but dotted in short turf among flowering plants, some of them aromatic (*Micromeria* sp., *Calamintha* sp.), and bushes. Near the top of the detached spur I found the only alchemilla seen on Damōta, the herbaceous *A. fischeri* (not in flower, nor seen again during the journey); also a beautiful large white *Swertia* (near *S. kilimandscharica*), not yet in seed, whereas a month later, on Mt. Tola in December, the large purple-flowered species, *S. lovenii*, was seeding freely. Among the denser scrub were two bushes, *inqoqo* (or *encoco, Embelia schimperi*) and *kachamo* (*Myrsine africana*), yielding strong purgatives, now produced in quantity at the Medical Research Institute in Addis Ababa; also a large-leaved bush with green berries called *imbis* (*Maesa lanceolata*) and a purple-flowered pea (*Tephrosia interrupta*), to which my camp-cook gave a Galla name meaning 'monkey's fruit'. In this scrub I also obtained a single white bloom of *Protea abyssinica*, the only instance in which I saw this small tree in flower, though many others, past flowering, were seen later, south of the Gughé mountains.

Farther up, but still some 800 feet below the top of Damōta, steep south-facing slopes were covered with low scrub, tall delphiniums (*D. wellbyi*), pink malvaceous flowers and yellow composites; or stretches of grass thickly sprinkled with *Caucalis melanantha*, the white star-like umbels of *Alepidea peduncularis*, and the pale lilac flower-heads of *Centaurea varians*. These, with a yellow and a white 'everlasting' (*Helichrysum fruticosum* and *H. argyranthum* and an orchid (*Habenaria peristyloides*), are all that can be mentioned of the plants on the main southern face of Damōta.

The easier gradients at the top lead on to grassy downs. Though the massif is doubtless of volcanic rock, it is apparently not a crater, at any rate not a single crater, as is Zuquāla. A deep cirque, with a narrow opening to the north-west, is hollowed out of the main mountain, but I cannot say how far this is due simply to erosion. From the highest point a smaller shallower hollow, probably a secondary crater, is visible on the side of a slightly lower summit to the west (Pl. 11).

The deep cirque recalls the great hollow from which a torrent (the Culūmsa river) flows on Mt. Chillālo. But whereas on Chillālo, 3,000 feet higher, the cirque and surrounding precipices are covered with woody-stemmed alchemilla and stunted tree-heath, on Damōta every possible space is cultivated. I gazed down into the great cirque on groves of tall bamboo in deep ravines, plantations of *enseté*-trees, patches of bush with *Dracaena*-trees and fields of ripening barley. At the top, round the edge, lie high pastoral land, turf close-cropped by sheep and cattle, fields separated by earthen banks out of which grow *kosso*- and *quolquol*-trees (*Hagenia* and *Euphorbia*). The landscape was a foretaste of the Gughé massif. Here and there stood grass-thatched houses, for many people live on the mountain-top. Their friendly head-man, small and old, wearing a tight red turban and a short black *burnus*, rode to greet me on a pony.

Père Azaïs states that the northern slopes of Damōta contain deposits of high-grade iron ore, from which excellent knives and lances are manufactured (A. & C., p. 273), but I did not see the workings.

Entomologizing on the summit: rounded grassy peaks, not varying greatly in height, partly encircle the hollow in the mountain. On 5 November in bright sunshine I climbed about 400 feet from my (tentless) camping-place outside a Wolāmo house to the highest summit, towards the east, at 10,400 feet. Immense tracts of country lie outspread southwards towards Lake Abaya, and westward over the plateau to distant ranges; no rival mountain, only its own sister-peaks, hide the distance in any direction from the highest point of Damōta.

On this bare grassy hill with flattened top (where the boiling-point observations recorded on p. 109 were taken) I collected insects for some hours, principally small beetles among the grass-roots and in loose soil thrown up by rodents.

Strongly-flying insects on bare mountain-tops: the most striking capture on the summit was that of four perfect specimens (all males) of the butterfly *Argynnis hyperbius* (race *neumanni*), a large and beautiful fritillary represented by a series of subspecies and races throughout its range from Australia to Ethiopia. The only *Argynnis* in tropical Africa, it occurs in no other part but

Ethiopia. In India the caterpillar is normally found on wild violet (as in many European species of *Argynnis*). In Ethiopia the food-plant will almost certainly prove to be the same; for *Viola abyssinica* doubtless grows in the bamboo-woods on Damōta, and I found this wild violet in the bamboo forests of the Gughé mountains, not far from (though hundreds of feet below) the bare grassy summit of Mt. Gughé itself, where I also saw a single specimen of the butterfly on 21 December.

On my earlier journey I captured examples of both sexes at lesser heights, between 8,000 and 9,000 feet, in Jem-Jem Forest and on Mt. Chillālo. In India, as Brigadier W. H. Evans has told me, grassy slopes rather than hill-tops are this insect's habitat. Yet in 1948 (excepting a single example seen on a high grassy hill-spur near Ezo, p. 138) I met with no specimens anywhere on the miles of high grass-lands traversed, but only on these two highest mountain-tops, Damōta and Gughé, on two fine hot days, nearly seven weeks apart.

This is a fresh instance of a phenomenon known but not fully understood. Very diverse insects, strong on the wing, are occasionally, under peculiar atmospheric conditions, attracted to bare hill-tops. For instance, in the Yemen, 1 February 1938, butterflies of at least five species (including a smaller fritillary, a *Melitaea* previously unknown) were flying about the narrow ridge-top of the extinct volcano, Jebel Kohl, an ash-heap with only scanty vegetation, reaching about 9,500 feet (Scott, 1942, p. 154).

In some of the species concerned it seems that only individuals of the male sex are attracted to the hill-tops. This applies to the specimens of *Argynnis hyperbius** on Mt. Damōta, while at several places in Britain examples of the Giant Wood-Wasp (*Sirex gigas*), exclusively males, have been seen flying, singly or in numbers, on bare hill-tops from 800 to nearly 3,000 feet high, the nearest woods being hundreds of feet below and several miles away (Scott, 1926).

Water-beetles leaving the water: other insects besides the *Argynnis* were behaving in an exceptional manner. In the afternoon I descended a little below the highest point to a spring, a film of water flowing down over a bare rock-face into a pool. Conveniently for the inhabitants, this pool is divided by a natural upward-projecting dyke of rock into an inner basin whence clear drinking water is drawn, and an outer pond fouled by cattle. There I found many water-beetles (Dytiscidae, comprising two species of *Agabus*, one possibly new to science), not in the pool as I should have expected, but in cushions of wet moss on the rock-face. Mr. J. Balfour-Browne tells me that the conditions, a hot bright day after a very cold night, and a fine spell after stormy weather, are just those under which he has found water-beetles disposed to leave the water and take to flight in Europe.

Perhaps the peculiar weather conditions induced exceptional behaviour in both the butterfly and the water-beetles. Together with the latter, in the wet moss-cushions, I discovered more than 30 specimens of a Carabid beetle new to science (a species of *Peryphus*); but this, which was found nowhere else during the journey, was behaving in a manner normal to its group (the subfamily Bembidiinae)—a terrestrial insect seeking a moist spot.

Sōddu (Wolāmo) to Chencha (Gamo) (16–22 *November*).

As explained (p. 113) the Rains had so damaged the track that motor-transport was impracticable. But though the journey of nearly 60 miles by mule-caravan occupied seven days including halts of a day apiece at Borodda and Ezo, this had the advantage (as I ever maintain in contrasting the old slow manner of travel with rapid mechanized transport) of allowing the country to impress itself on the traveller's memory.

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* In *Argynnis hyperbius neumanni* the male lacks the white subapical band on the forewing, present in the female. Differences in habits between the two sexes are known in some other butterflies.

Descending (16 November) from the Mission Station on its mountain-promontory, I traversed a monotonous plain of short turf with tussocks of tall grass and low flattened tumuli, apparently formed by grass overgrowing ants' nests. On 17 November we rode a short stage up and down the sides of Humbo (or Umbo, also written Wambo). Though this massif is stated to reach 8,890 feet, the track, considerably lower, lay through dry brown grass and vegetation of a dry-country type. Yet colour was not wanting though, apart from yellow Compositae, orange, deep red, mauve and purple hues predominated; single plants or patches of orange-red aloes, many deep crimson globe-thistles (*Echinops amplexicaulis*, cf. p. 129), a tall, prickly, branching, deep purple acanthus, and a coarse-leaved, tall, spreading bush-convolvulus, with flowers pale lilac shading to deep purple in the centre (*Ipomoea cairica* ?). The acanthus, probably *A. eminens*, was now coming into flower, while the lower scarlet-flowered species, first seen farther north (p. 128), was going over.

On a bare level market-place boys, clad only in a sheepskin or cow-hide fastened round the neck and flapping loose over the shoulders (or without any clothing at all) were playing the Ethiopian *gana*, a game rather like hockey. Their clubs were straight, thick and broad at the end, not curved. The wooden ball was only approximately spherical and about as large as a small orange (possibly it was a hard ' knot ' out of timber). Though *gana* is played without goals and with varying numbers of players on the two sides, yet the teams were trying to hit the ball back to the end of the ground whence it came. Negussie told me that *gana* was introduced into the southern provinces by the Christian Ethiopians farther north, but is now general; also the season for the game should properly begin at Christmas (*Gana* is the name of the Ethiopian Christmas Eve, 6 January). He said that in Addis Ababa the wooden balls used to be polished with leather and dipped in the blood of an ox, which made them hard as iron, but this is now forbidden, as the players often lost teeth, or suffered injuries to the eyes, or other hurts. Mr. David Buxton (1949, p. 87) writes of *gana* being played by the boys and young men of neighbouring villages, the villages themselves being in some cases the goals—in Shoa, and in country less mountainous than that surrounding the market-place at Humbo. Hodson describes (1927, p. 187) violent incidents which occasionally arose out of this game.

I have just touched on *gana* as the game which a traveller is most likely to see. But the peoples of Ethiopia have many other games. M. Marcel Griaule mentioned several in the book cited (1934), where he also noted (p. 163) that a collection of 430 games and variants was in the press under the title ' Jeux et divertissements abyssins '—an indication of the magnitude of the subject.

Though I have prefaced this Report with a passage from Wylde's ' Modern Abyssinia ', I cannot literally agree with his remark that ' in the Abyssinian uplands no day ever seemed too long '. The trek (18 November) from Humbo to Borodda *was* too long for men and animals. But a ride of 25 to 30 miles, lasting from 8.30 a.m. to 6.30 p.m., was needed to cross an uninhabited low-level expanse and to reach a suitable halting-place.

The track led down from red to black soil, where occasional cotton-fields appeared. Much of this country is well under 6,000 feet, probably under 5,000 on the uninhabited expanse of long grass where the road is guarded by police (p. 117). The grasses, specially at the lower levels, were impressive from their varied habit and the striking cinnamon-red and other colours of their inflorescences. Though hustled along, I managed to collect the following nine species: *Aristida adoensis*, *A. adscensionis*, *Eragrostis pseudosclerantha*, *Harpachne schimperi*, *Heteropogon contortus*, *Melinis tenuissima*, *Pennisetum ramosum*, *Rhynchelytrum repens*, *Setaria pallide-fusca*. The *Pennisetum*, found at the lowest level, is a man-high grass with rather broad leaves and catkin-like inflorescences. The tall *Melinis* excels in the gracefulness of its inflorescence and the hair-like slenderness of its stems.

In the long ascent of more than 3,000 feet to Borodda, the track soon led once more on to red soil and into bush—bush tantalizingly like an English countryside to a hot and tired traveller, for small broad-leaved trees, about the size and shape of fruit trees, stood at just the right distance apart to resemble orchards. But despite this superficial resemblance I was reminded where I really was by suddenly coming on some camels of a tall reddish breed browsing in the dense bush. To prevent them straying the owners had fastened round the neck of a huge male camel a wooden bell; later, at Ghidolé, I secured one of these bells, quite musically sounding and entirely of *Podocarpus*-wood. My men were surprised to find a herd of camels in this district, west of Lake Abaya.

A resting-place for caravans at a point where several tracks meet was shaded by several very lofty wild figs and fairly tall *tirucalli*-trees (*Euphorbia tirucalli*). Then, mounting by degrees through seemingly unending bush, it was pleasant to turn a shoulder of the hills and see at last the patches of newly-ploughed land, green crops and *enseté*-plantations, surrounding Borodda. This rather untidy straggling *katamā* (town) is the centre of Borodda district, now administered by a Fitaurari and included in the Province of Gamo-Gofa. Earlier in the day we had passed a mark on the track, showing the boundary between Wolāmo Province and Borodda. On the western outskirts of the town, at about 8,200 feet, I halted for a day (19 November) to rest men and animals and to prepare and pack specimens. The latter included several Carabid beetles of wide-ranging African species, characteristic of the middle altitudes, found during 15 minutes' collecting under stones at the edge of a small river flowing from the west into Lake Abaya.

The watershed crossed: though the next ride (20 November) covered only seven or eight miles as measured on the map, it was really considerably longer. After a long descent from Borodda, a climb led up and over a range lying roughly south-east to north-west, at an angle to Lake Abaya; then down again into a steep-sided chasm and up a long ascent till we camped at more than a 1,000 feet higher than our starting point, a little north of the town of Ezo. Negussie had wished to reach or even pass Ezo but, having started before 8 a.m., mules and men had done enough by 2.30 p.m.

The final ascent towards Ezo traverses a noteworthy watershed, between the short rivers flowing eastward towards Lake Abaya and some tributaries of the Omo flowing in the opposite direction. My camp north of Ezo overlooked one such affluent, a sizeable rushing river, flowing in a chasm which extends first northward, then curves round to the west. This was the only point where I touched the vast Omo-system, which extends well over 300 miles from north to south, where the main Omo debouches into Lake Rudolf. I had read of the immense 'graveyard' of giant mammals of the late Tertiary and the Quaternary (Jeannel, 1934) near the lower reaches of the Omo, and was consequently thrilled to view even one of its tributaries.

Lakes Abaya and Chamo: as the country became ever more mountainous, parts of Lake Abaya and its islands were from time to time visible to the east, framed by the bold outlines of the ranges (Pl. 12). I had already seen the north end of the lake, more than 20 miles away, from Sōddu and Mt. Damōta. From Borodda onwards, travelling abreast of it, I got not only these partial glimpses but, from the highest parts of my route, wonderful panoramic views of both lakes, Abaya and Chamo (Pls. 12, 15). But though my route encircled them, I was for the most part high above and tantalizingly far away. The floor of the depression, more or less bush-covered and appearing from above nearly flat, extends a considerable distance between the foot of the highlands and the lake-shores. As I never reached the latter, I cannot describe the beautiful native boats (see Buxton, pl. 49).

The two lakes contrast remarkably in colour. Abaya, from the amount of red soil swept down into it, is pink, during the later part of the Rains quite rose-coloured. Chamo in sunny weather is a bright, clear blue*. The sentiment of Père Azaïs (A. & C., p. 266), expressed in his phrase 'le lac Margherita dans sa splendeur teintée de rose' (on 2 October 1926) may not be universally shared, as some do not think rose-pink beautiful in a lake. An American lady-missionary, comparing the scenery unfavourably with her native state of Maine, ironically remarked to me that Lake Abaya was 'not even blue'. Yet the two lakes as I saw them from many high points on the west, their contours and islands, the colours of their waters contrasting strongly with one another, and with the bright green marshes, duller green bush and desert-brown grass round their shores, all framed by grim mountains, form a splendid and memorable scene.

The vapour rising by evaporation from the basin of Lake Chamo in December was at times so dense that I at first imagined it to be the smoke of burning grass. I do not know whether these two lakes are shrinking from excess of evaporation over inflow. Nor do I recall seeing vapour rising from the surface of the larger lake though, as Père Azaïs remarked (A. & C., p. 264), the 'profusion of rivers' is not too great to maintain so large a body of water as Lake Abaya. Evaporation may be proportionately greater in Lake Chamo, about 23 miles long, with an area roughly 212 square miles, as against a length of nearly 44 miles and a surface of nearly 485 square miles for Lake Abaya†. Also the water of the smaller lake is stated to be slightly saline, while that of the larger is fresh. Yet Hodson (1927, pp. 32, 33) found withered trees standing in water near the shore of Chamo in 1915, indicating at any rate a temporary increase in volume. Despite fluctuations, however, the conformation and marshes at its southern end, seen from Ghidolé, seemed to me to indicate shrinkage. (On p. 110, I have mentioned the remarkable difference in level, Chamo being about 172 feet lower than Abaya).

Camp north of Ezo: this was pleasantly situated over 9,000 feet above sea-level, on a flat-topped hill-spur. Tussocks of tall coarse grass stood at rather wide intervals in the close-cropped turf, while the spreading stems and purple-tinged white flowers of a campanula (*Wahlenbergia silenoides*) were intertwined with the haulms of almost every tussock; being then unaware of its identity and of the superficial resemblance to a *Silene* implied by its specific epithet, I wrongly took it for a caryophyllaceous plant. A small white-flowered *Swertia* was plentiful, and a few small plants grew nearby of *Blaeria spicata*, a rose-pink heath which I had found on Mt. Chillālo in 1926 but never saw, except at this one spot, in 1948–9 (concerning its southern affinities, see p. 151). Places where the soil was exposed, such as the steep banks beside hollowed-out paths, were bright with the vivid magenta-pink flower-heads of a low-growing composite, *Emilia* (perhaps a new species), only seen north and south of Ezo.

Insects abounded. Clouded-yellow butterflies (*Colias electo*), the world-wide Painted Lady (*Vanessa cardui*) and a single example of the large fritillary (*Argynnis hyperbius*; *antea*, p. 135), grasshoppers of high-altitude type and flower-haunting beetles (Lagriidae, Mylabridae, Malachiidae). In a valley behind the camp I captured some interesting, short, stumpy *Tetrix*-grasshoppers on a steep face of wet earth beside a spring.

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* No doubt the colour varies with the season and also in different years, according to the heaviness or otherwise of the Rains. The survivors of Bòttego's Expedition (Vannutelli e Citerni, p. 266) record how the newly-discovered Lake Margherita appeared, in early June 1896, 'tranquil and clear as crystal, with opal reflections and delicate shades'. They also noted the azure blue of Lake Chamo.

† These dimensions are based on the fuller data given in kilometres in the *Guida* (pp. 552–3). I am indebted to Mr. F. George of the Royal Geographical Society for converting the areas, respectively 1,256 and 550 square kilometres, into square miles.

Discrimination of colours by a hover-fly (*Syrphus*) : on this open grassy hill-top I captured two specimens of a widespread but variable African hover-fly (a variety of *Syrphus adligatus*), which hovered persistently close round me, as though attracted in some way. I cannot recall noticing such behaviour in hover-flies in any country before. Syrphidae are not biting flies and not ordinarily attracted to the human person. But in one case it has been shown that a Syrphid fly prefers certain colours. A preliminary account * of experiments on the common European drone-fly (*Eristalis tenax*) indicated that these flies persistently chose a particular ' saturated ' yellow from among several yellow shades ; also that they could be trained to discriminate between certain shades of blue. I think that the hover-flies near Ezo may have been attracted to my coat, an old garment originally khaki-coloured, but faded by exposure on several tropical expeditions to a pale yellowish-brown or, in parts, whitish shade. The two specimens are males, so their behaviour could not have been connected with the mode of egg-laying in this species.

The whole countryside is closely cultivated, or grazed to the very tops of the hills by sheep and goats. The only cereal was young green barley in terraced fields, though not on elaborate stone-faced terraces as at Konso or in South-West Arabia (*infra*, p. 159). At Ezo and in the Gughé Highlands proper the terraces are but two or three feet high, with earthen faces, perhaps strengthened with stones here and there, but no more †. Moreover the surfaces of the fields are not level, but slope downwards. In this land of abundant rain no system of channels for conserving every drop of ' run-off ', such as exists in South-West Arabia, is needed.

Besides barley, the landscape is varied with plantations of *ensete*-trees and with neat groves of bamboo surrounding springs in ravines, also some fields of purple-flowered beans (*Vicia sativa* ?) in the valleys. Men and women were digging ' Galla potatoes ' (*Coleus edulis, antea*, p. 129) with two-pronged mattocks (Pl. 9). From here to the southern part of the Gughé Highlands no ploughs are used. All trenching and turning of the soil is done with these mattocks, the long, sharp prongs of which are bound to the wooden shaft with leather (perhaps also partly with fibre) and stayed by cords stretched from about the mid-length of each prong to the shaft.

Houses and fortifications of Ezo : the sky-line a few miles south of my camp was fretted by eucalyptus trees. These largely conceal the triple earthworks with which Menelik surrounded this *katamā* (town), one of the outposts founded by him during his conquest of the southern kingdoms. Though a large space is enclosed, houses within the ramparts seem now to be few. About Ezo the skep-like houses are more steeply conical than in Wolāmo, and some are partly or wholly thatched with *ensete*-leaves instead of grass.

Ezo to Chencha (22 November) : the route, attaining over 10,000 feet, crosses a ridge, winds along a broad lower tract, ascends again and leads across a pass, in the middle of which stands a conical forest-covered hillock, densely wooded with *kosso*-trees (*Hagenia*) and bamboo. Rising like an island amid the grain-fields which fill every available site, this eminence has been spared deforestation partly owing to its steepness, no doubt, but also to its sanctity. Tradition asserts that many churches once stood on the hill and, though this would be scarcely possible in the space (the story was treated as empty legend by Fitaurari Kabudda at Chencha), yet some sacred rock, tree or spring may have formerly attracted anchorites to the place.

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* Dr. Dora Ilse, *Nature*, **163**, 255–6, 1949. Mr. R. L. Coe, who kindly determined the Ethiopian Syrphid, also called my attention to Dr. Ilse's article. Mr. L. Parmenter has now recorded three common British Syrphidae as attracted to yellow objects in London streets (*Ent. mon. Mag.* **88**, 50, 1952).

† In *The Times* of 13 February 1951 appeared photographs of terraced hills in Kigezi, western Uganda, having much the same appearance.

The lovely everlasting-flower, well-named *Helichrysum formosissimum*, since the outer bracts of its large flower-heads vary from white, tinged or edged with rose, to deep crimson, appeared for the first time on this journey on the high ground north of Chencha. In 1926 I collected it about 150 miles to the north-east, on Chillālo; in 1948 I found it abundant at the highest altitudes in the Gughé mountains till south of Bonghé. A brief comparison of the Helichrysums found on the mountains visited in 1926 and 1948 is given below (p. 151).

As to flowers in general, between Borodda and Chencha I passed (but could not collect specimens from) thickets of bush left in places too steep for cultivation, bright with tall yellow Compositae, a tall rank-growing dark blue Labiate, clusters of pink bramble-blossoms, sprawling white cranesbill and *Clematis* (possibly *C. simensis*) passing to the 'old-man's beard' stage. These colourful wild herbaceous borders had a late-summer appearance by English standards.

CHENCHA AND OCHOLLO MARKET (22 *November*–2 *December*).

Chencha, situated somewhat below 9,000 feet (see p. 109), is a large, straggling town, densely embowered in blue-gum trees. Formerly the provincial capital of Gamo, it now looked half deserted, the present Governor of Gamo-Gofa having transferred his seat about 78 miles south, to Ghidolé. The Government buildings, now occupied only by a district chief, a Fitaurari, display much neat construction in bamboo. Slats made by splitting the canes, interwoven not singly but in groups of six or more, form the pillars of gateways, also fences and walls of rooms. But parts of this elaborate work were dilapidated after years of neglect.

There were, in fact, two Fitauraris, one of whom, Kabudda, had apparently been sent to replace the other, Kanko. They were both tall, thin men, well over six feet, while the Fitaurari of Borodda, who had travelled south to consult with his colleagues, was also very tall, though stouter in build and having features of a more Semitic cast. These three, with the tall Fitaurari Katta of Bonghé and the still taller Governor of Gamo-Gofa (both of whom I met later), all seemed members of a 'governing class', towering physically and otherwise above the local people. The dress now favoured by such chiefs is mainly European, including a topee and a very long military overcoat.

Fitaurari Kanko occupied a large *ghibbi*, a group of rambling buildings a mile from the town. He was, at my first visit, shuddering from fever, huddled on a couch covered with an oriental carpet, before a wood fire burning on a low square iron stand almost in the middle of the room. The floor was strewn with hay, while the dried-mud surface of the walls probably concealed a wattle-framework.

Fitaurari Kabudda, on the other hand, entertained me, Negussie and Ghidello in the bamboo-built Government edifice. From now onwards I had perforce to accept the hospitality kindly offered by various chiefs, though I avoided (for dietary reasons) not only the raw meat, traditional culmination of the meal, greatly relished by my retainers, but also the dishes of cooked meat and chicken seasoned with fiery *berberi* (chillies). But hard-boiled eggs in meat-sauce were liberally supplied, and I could enjoy the *injera* (bread made from *teff*-flour), *tej* (mead), tea and coffee, while European spirits and *anis* (distilled at Addis Ababa) were provided in embarrassing quantity. A local product new to me was *tchuko* (a word beginning with an explosive sound), a paste made of barley-flour and butter; though to my taste it had been better sweetened, its consistency was agreeable*. The attractiveness of these repasts was lessened by the use of cheap imported utensils.

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* Probably its composition varies in different places. Donaldson Smith (1897, chap. vi, p. 77) was given 'dishes of *chuko* or ground *dhurra* meal, baked in butter and thoroughly browned, and seasoned with pepper and salt'.

An important market: a large country market was held on Thursdays at Ochollo. Thither I rode some eight miles downhill towards the lake, through country largely cultivated but dotted with great old forest trees (not coniferous), thickly festooned with lichen. At Ochollo only a few thatched buildings stood along either side of a wide grassy space. There a great concourse assembled out of nowhere as it seemed, but really by winding paths leading thither from the little groups (*agglomérations*) of dwellings scattered over the countryside. Some of the vendors sat on smooth boulders, ranged in rows along one side of the market-place, but most were seated on the grass. Besides sheep and goats, raw cotton (from lower altitudes), various grains, and gourd-vessels were on sale. The use of bamboo and gourds is exemplified in the local form of hubble-bubble or water-pipe, the long stem being a hollow bamboo and the water container a gourd, while the bowl, to hold the charcoal and tobacco, is of course dark earthenware. Cups and bowls of dark ware, of distinctive shapes in each district, were obtained at several markets during the journey; in Wolāmo the little handleless coffee-cups had simple engraved patterns picked out in white.

A man at Ochollo market was distinguished from his fellows by wearing a black sheepskin stole round his shoulders, and by carrying a long staff with spirally twisted brass top. These things were not (I was told) badges of official rank, but merely denoted wealth and importance. Perhaps this custom may be compared with the distinction, recorded by Griaule (1934, p. 41) in Gojjam, between landed proprietors who carried both a spear and a stick, and other men carrying only a spear.

Collecting round springs and under boulders: my camp stood in a level field enclosed by a bamboo fence, adjoining the Government buildings. Distant hills with gentle outlines rose to the north, for the most part treeless and covered with grass and cultivated land. Immediately north-east of the camp the ground fell steeply to a stream, broadening into pools full of water-mint and aquatic plants. Several springs, round which I collected insects, welled out on the steep slope. With crowbars and spade we overturned large boulders deeply sunk in the turf, obtaining from the soil underneath beetles of special interest, permanently or temporarily subterranean in habits (Carabidae, Staphylinidae, Histeridae, Anthicidae). One of the Carabidae has proved to be a new species of a totally blind genus (*Caecocaelus*), not a microscopic beetle as are the Anillini (pp. 101, 152), but a Pterostichine about $\frac{1}{4}$-inch long (the description by Dr. Straneo will appear in the Society's *Journal*). Only three other species are known; the first was found near a river in Ethiopia given as 'Bulo-Buli', the whereabouts of which cannot be traced*, the other two in the mountains of Kivu.

Ibis and a legend of their longevity: as a diversion from collecting beetles I twice succeeded in quietly following and watching a serval. Also a flock of the endemic† ibis *Bostrychia carunculata*, having dark plumage with green reflections, and white marks in the wings, fed daily on the ground in the valley. At night they roosted in the eucalyptus trees behind my tent, where their hoarse croaking, even before dawn, contrasted with the shrill yapping of jackals earlier in the night, and vaguely recalled the cawing of rooks.

Seeing later more of these ibis in the Bonghé valley, Ghidello then told me that the priests have a saying that this bird lives to a great age, a century or more. Perhaps such an idea is related to the beliefs associated with the Sacred Ibis in ancient Egypt.

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[*] Possibly it is the Bulbulla, a river rising at a high altitude east of Lake Shala, into which it flows; but such a name may repeat itself in different parts of the country.

[†] Endemic to the Ethiopian highlands, but probably not hitherto recorded from so far south. The white markings in the wings made the identification certain.

Chencha to Bonghé (2–5 *December*).

Doubts expressed by friends as to whether I should find a ‘Mount Gughé’ at all were soon dispelled after arrival at Chencha on 22 November. People at once knew where I wanted to go and preliminaries were soon arranged with a new *nagadi* who, with his assistants, professed to know the Gughé district well and to own ‘properties’ there. Yet they did not assemble their beasts, largely horses this time, till 1 December, and then so late that we refused to start till next day.

Starting after midday on 2 December, a beautiful day after a cold, wet and windy night, I trekked south-west for four days (including a day's halt) to Bonghé, in the heart of the Gughé mountains. Descending slightly from Chencha we forded at least one fairly wide river, flowing swiftly over stones towards Lake Abaya in a pretty valley. In the lower places, between 8,000 and 9,000 feet, groups of men and women were already reaping barley with the small saw-toothed sickles of the country; this contrasts with a method of harvesting seen in the southern part of Gughé, where (31 December) barley was being dragged out of the ground by the roots.

Where the track turns westward, leading up and down over the outer spurs of the massif, the hill of Dorsé forms a precipitous-sided promontory jutting into the lower country to the east. On this natural fortress, connected to the massif by a ridge so narrow that two people (I was assured) could not walk abreast, the last chief of the Dorsé people made a stand against Menelik. The ridge, viewed through field-glasses, looked just such a knife-edge.

I was now abreast of ‘God's Bridge’, between the two lakes. To shorten my journey after visiting the Gughé mountains, I wished to cross this isthmus and to join the northward route through Sidāmo between Agheré-Maryam and Dilla. But no one would conduct me. Negussie, an old victim of malaria, feared being obliged to spend the night near lake-level. The *nagadi* feared the effect of harmful plants on his grazing mules. And the uninhabited isthmus and adjacent shores, covered at that season (as I verified with field-glasses) with long dry grass, not usually burnt till March or April, might be infested with *shiftas*.

Wūbara: approaching through groves of tall bamboo a rough wooden bridge, we crossed another pretty mountain torrent, and spent the next day camped in the grassy valley on the far side. The *nagadi* called the place and the river ‘Wūbara’, but spoke of a *katamā* (town) of Gulta close by (Gulta is mentioned by Azaïs and Chambard (pp. 264–5), who also name two rivers, the Haréré and the Guiné, between this point and Chencha; but I cannot exactly name the several torrents crossed). Below the site of my camp the Wūbara enters a winding gorge so narrow, and with sides so overhanging, that I could nowhere get a sight of a cascade audible from the camp; while nothing could be seen of a little tributary stream beyond the place where it slid over the brink of the gorge.

In these torrent-valleys, where the bamboo woods stand among pastoral and agricultural land, the landscape is softer, with a beauty akin to that of many lovely places in Europe. Otherwise much of the scenery in this part of Ethiopia is grim. North of Borodda, for instance, the hard stony ranges, grass-covered hills, scrub and patches of cultivation, present views constantly changing as one rides along, yet never culminating in any one striking feature.

During the day (3 December) well spent at Wūbara, interesting beetles, especially certain weevils, were beaten from low scrub of *Rubus*, *Maesa* and other bushes above the mouth of the gorge. Later I searched for the first time the dark humus under bamboos, being well rewarded by subterranean-dwelling beetles (Carabidae, Staphylinidae, Scydmaenidae, Pselaphidae and—most minute of all Coleoptera—Ptiliidae).

Names of the principal Gughé mountains: on 4 December, five hours' riding, at first over high rounded mountain-spurs, where the short turf is full of stalkless white thistles, led in the late afternoon towards Mt. Tola (Pl. 13), the dominating mountain of the Gughé Highlands and of my whole journey. In the Italian *Guida* (p. 552) the track across the face of the escarpment, along which I passed next day, is named *la stretta di Tola*, but the mountain itself is called *M. Gughé, che domina tutta la regione.* This does not accord with what I learnt by careful inquiry from local people during nearly a month's stay on or near the mountain. The name *Tola* connotes not only the track but the mountain itself, while the name *Gughé* is applied to the twin peaks (Pl. 17) about eight miles to the west, and even more to the cultivated district beyond and below those peaks.

Though lacking snow Mt. Tola is extremely impressive. To the north the highest narrow terraces of young barley extended upwards to well over 11,000 feet, striping the steep slopes with bands of brilliant green, separated by the dark lines of the low earthen terrace-faces (Pl. 14). Even the *enseté*-trees and the scattered *kosso*-trees, hung with clusters of red flowers, do not climb as high. To the west and south, from the point whence the photograph was taken, stretches a precipice so sheer that I could scarcely look over the edge.

To the west, in shadow against the sun declining behind the mountain, the precipices descend in steps for several thousand feet at least. Though grim and forbidding in form, they were everywhere green. The top of every step is closely cultivated and dotted with groups of houses. Footpaths zigzag over all but the steepest declivities. Bamboo and low scrub cling to gradients too sharp for cultivation or even grazing.

Dita: before I could cross the great escarpment next day a long descent had to be made to a river, immediately south of which camp was pitched at Dita, at almost 10,000 feet. As at Wūbara, the night was accompanied by the pleasant sound of a torrent.

Beyond the short turf and bracken of the camping-site were thickets of *Kniphofia*, only one spike of which, partly orange and partly yellow, was still in flower. A herbaceous-stemmed alchemilla (not in flower) grew about six inches high on the grazing-land but up to two feet among the kniphofias; patches of boggy land were starred with the white flower heads of *Eriocaulon schimperi*, only met with at this spot; and scarlet acanthus, still blooming at this altitude, formed a background.

Hypogaeous beetles were not to be found (perhaps the soil was here too wet) but black shiny weevils (Otiorrhynchinae), shaken from the dead but still hanging Kniphofia-leaves, prove to belong to a new species of *Neomias*, distinct from any member of that genus discovered on Zuquāla or Chillālo in 1926. Hustache, who erected the genus (1936, pp. 433–9) to include those discoveries, remarked that yet other species, inhabiting Mt. Kenya and Mt. Elgon, should be referred to *Neomias*—another instance of a genus being represented by distinct species on separate mountain-massifs (see p. 100).

The eastern escarpment of Mt. Tola: a ride of seven hours (5 December) was spent mainly in crossing the face of this huge escarpment. Under the Italian régime a track, parts of which lie above 10,000 feet, had been cut, but the surface was never made into the intended motor road. Here and there earth and rock had collapsed on to the track, leaving an uncomfortably narrow passage. Wherever the road crosses ravines its steep surface is full of rocks and holes. In such places small streams, descending from the cliffs above, flow across the road and spill over the brink of the sheer outer edge; as no splash was audible, the water evidently falls a long way in an unbroken drop. We met a fair number of passengers, mounted or afoot, as well as pack-horses and mules. Like all mountain folk, the people were quite insensitive to the dizzy heights, but I preferred to cross the ravines on foot and to avoid looking over the edge into the chasms below, though I remained mounted while passing over the projecting mountain-spurs.

The talus-slopes extending from the foot of the topmost precipice to the track bear patches of bush, while their more open spaces form the richest and most varied garden of high-mountain plants seen on the whole journey: bush-senecios (*S. myriocephalus*) six feet high, light blue delphiniums, low bushes of a woody-stemmed *Lotus* sprawling over rocks, with clusters of little flowers, purple paling to white, and black pods (probably a new species; the seed collected has not germinated), everlastings with pure white or yellow flower heads (*Helichrysum gulielmi*, *H. foetidum*, *H. argyranthum*, etc.), a tall branching *Swertia* (a variety of *S. lovenii*) with its maroon-purple bells hanging down, though later its seed-capsules turn upwards; and giant club-moss (*Lycopodium clavatum*) festooning the rocks. The above are but a selection. In smoother places the turf, browsed short, is full of a little procumbent plant related to campion (*Lychnis*), with flowers either pink or white (*Uebelinia*, an unidentified species).

Insects not seen before were also immediately forthcoming: for instance, large ground-beetles (*Orinodromus gestroi*, a species common throughout the Gughé heights, where a single specimen was originally found by Bòttego's Expedition in 1896) were running about the track. I also shook some small beetles from the many flowers.

Much longer might profitably have been spent there, but we had still to turn the end of the escarpment and descend about 1,700 feet on the western side of Mt. Tola, by a steep and stony track leading down to an affluent of the Cullufu River. Fording this and another torrent beyond it, we at length reached the camping ground, a small expanse of grass adjoining the track, assigned to us by Fitaurari Katta. He, the chief of Bonghé District (to whose help in the Gughé Highlands I owe much), here met me with his attendants. He at once discussed arrangements, told off an Amharic-speaking *shūm*, one Ato Gabré, to assist us, and in a quiet tone of authority settled a loud dispute which had arisen between Negussie and the *nagadis*.

THE BONGHÉ VALLEY, MT. TOLA AND MT. GUGHÉ
(5–30 *December*).

This valley, extending in a westerly direction through the mountains, has an extremely neat appearance. Part of its floor is a flat open grassy plain used for grazing, along which meanders a stream fringed by dwarf willows (*Salix* sp., not identified). But the steeply undulating north side of the valley is so closely cultivated that my men, on first arrival, were astonished at the lack of camping-space for caravans. Fields of barley, usually neatly enclosed in fences of split bamboo, meet the eye almost everywhere, and are carried up steep gradients on the surrounding mountains. There are also some *enseté*-plantations, though the valley lies above 9,000 feet, near the upper limit for this tree. Many of the scattered houses have gardens of tall cabbages, six to seven feet high (an unidentified species; Pl. 16), said to live three or four years.

The name Bonghé signifies primarily the district, an extensive one, places in which are far apart. It needed a long ride, up and down between barley-fields, to visit the Fitaurari at his private house on the north side of the valley. He rides almost daily a long way to transact affairs at the *katamā*, Baza, high up (9,500 feet) on the south side. Baza is a small fairly compact town on the Shoan plan, with a broad market-place. Apart from this the skep-like houses stand in scattered groups. The *tamāri bēt* (school) stands solitary between the Fitaurari's house and Baza. The school-boys were marched in a column to

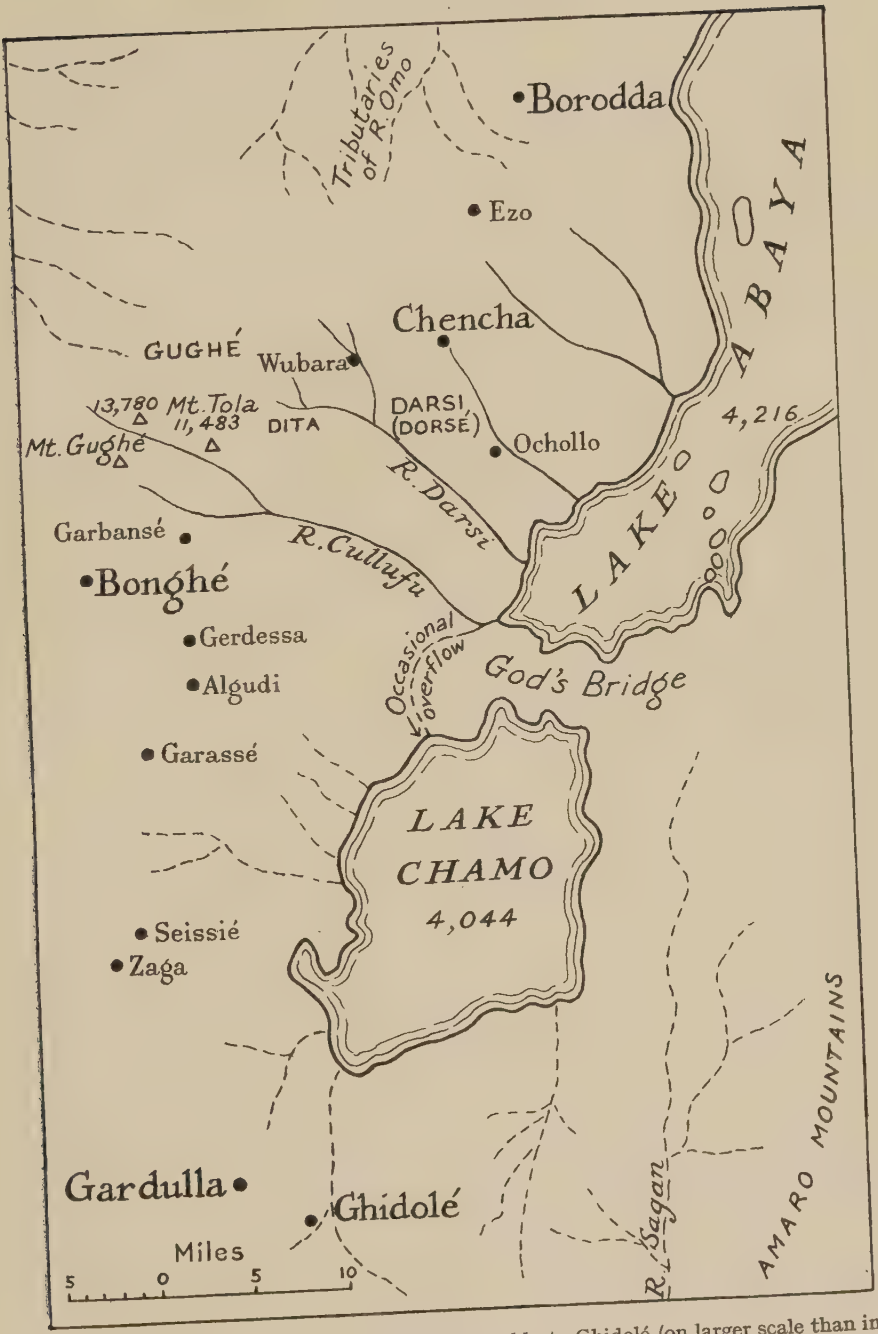

FIG. 6.—Map of country traversed from Borodda to Ghidolé (on larger scale than in route-map).

my camp, where the Eritrean hospital-dresser administered a dusting of D.D.T. powder to their heads, after which they saluted and sang an anthem in praise of the Emperor.

This district affords an extreme instance of the fact that in Ethiopia, while the highest and most inclement mountain-tops are uninhabited, and malarious places in the lower middle altitudes are also avoided or sparsely populated, all the zones of altitude between these limits are densely populated; even though in many districts compact villages are few and the people dwell in small groups of houses. I could often have echoed the remark recorded by Dr. Poncet in northern Ethiopia in May 1700 that 'markets are to be found everywhere . . . the country swarms with people' (1709, p. 144).

The smallness of the camping ground resulted in lack of privacy. The rare advent of a European aroused such curiosity that men crowded round the rather cramped uneven space. Even after returning to the heights of Mt. Tola, shepherd boys frequently 'coo-eed' to one another across the camp, but their loud shrill calls, beginning at early dawn, were varied by more pleasant notes played on their bamboo pipes.

Scarcity of certain products, etc.: the local Gamo people apparently do not use certain products elsewhere general. According to Negussie they do not brew the powerful taenicidal purge from the flowers of the *kosso*-tree (*Hagenia*). My men complained of the scarcity of teff-flour, finding only the unground grain for sale at Baza market. Eggs also were hard to get ; several people who, by the Fitaurari's orders, brought eggs for sale, produced addled ones which had to be thrown away before the would-be vendor's eyes.

Nesting-season of birds: this scarcity of the eggs of domestic fowls led my men to bring me, on 19 December, some eggs of a wild game-bird from the high slopes of Mt. Tola ; ochreous with dark blotches, they were probably those of a francolin. I noted that these birds were nesting above 10,000 feet on that date. But on 10 January 1949, in dry bush near the Sagan River, below 4,000 feet, we found nestlings of a game-bird, probably also a francolin. It does not, therefore, appear that the altitude is a deciding factor in this case.

Till more information is forthcoming, a general statement about the nesting-season in Ethiopia would be unreliable. Mr. R. E. Moreau has omitted Ethiopia from his valuable study (1950) of the breeding-seasons of African birds as a whole, owing to lack of sufficient data. He told me that, while most birds (excluding hawks and other raptors) may be expected to lay just before, or early in, the Rains, there will be many exceptions, depending on the habitat of each species and the niche in the ecology occupied by each. His work cited above shows how complicated the question is. But some conclusions are given, as (for instance) that raptors and scavengers are the earliest breeders, some species laying eggs in the height of the dry season ; that ground-nesters tend to lay as soon as the grass-fires are over ; while grass-birds lay later than most, when the grass has grown high.

My very few personal observations* indicate that, even if most Ethiopian birds nest early in the Rains, some nest towards their end. These species may be exceptions to the general rule, or the broods raised at the end of the Rains may not be their first. The following instances apply to the country near Addis Ababa :

A weaver-bird was seen building a nest late in August 1948. In 1926, on 18 September I flushed a Black-headed Siskin (*Spinus nigriceps*) off a nest containing two eggs, in a globe-thistle (*Echinops*) ; and on 20 September I watched a pair of Ruby-cheeked Cordon-bleus (*Uraeginthus bengalus*) constructing

* Such published records of the breeding-season of Ethiopian birds as exist are scattered in several journals over many years. While I am greatly indebted to Mr. Moreau for sending me a list of references, I have been unable to follow these up. Owing to the need of bringing this Report to a conclusion, I have only recorded my own observations.

the frail framework of a domed nest in a thicket. These latter notes were made west of Addis Ababa, the former at Gafassa (about 8,400 feet), the latter at the Berga River (about 7,400 feet). Birds' nests are, generally speaking, very hard to find.

Strange behaviour of a hoopoe: though out of chronological sequence, I add here a record of a curious encounter between a black-and-white kingfisher (*Ceryle* sp.) and a hoopoe, witnessed at the Suksuki River, 27 January 1949. The kingfisher was perched on a branch overhanging the water. The hoopoe flew up, the kingfisher then rose into the air, and the two danced up and down in flight, keeping level one with the other. This was repeated several times, the kingfisher returning to its branch between the dances, till at length the hoopoe flew away and left it in possession. So far as I could see, neither bird touched or struck at the other.

Agricultural work on Mt. Tola: having concluded arrangements with Fitaurari Katta, I returned on 9 December up the 1,700 feet to the shoulder of Mt. Tola, at the southern end of the high escarpment. Here I camped till 26 December at approximately 10,600 feet, on grass-land so steep that a rough levelling with mattocks was needed before my tent could be pitched.

From this level downwards the peasants were busily planting potatoes (ordinary, not sweet), small round tubers sent from Addis Ababa, whither the resulting crop was to be transported. Men, wearing only loin-cloths, were deeply trenching the rich black soil with the two-pronged mattocks (cf. Pl. 9), while women almost as lightly clad flung basketfuls of the dug-out soil over the surface. Even if ploughs were used in the district, ploughing would be impracticable on many of these slopes as the fields on the west side of the mountain are not terraced.

Abundance of flies (*Musca*): the potato-planting called for liberal use of manure, many heaps of which lay near my camp. Consequently I was distracted by flies during the warmer hours of the day. Only by frequent assaults on these persecutors with a 'flit-gun' and D.D.T. emulsion could I get peace enough to prepare delicate specimens in my tent during the afternoon.

In 1926 I wrongly concluded from experience in uninhabited places that flies were almost absent, or at any rate not numerous enough to torment, above 8,000 feet. However, the degree of their prevalence clearly depends not on altitude alone. Doubtless temperature and various local conditions affect their numbers.

Mole-rats (*Tachyoryctes*): the cultivators on Mt. Tola were suffering from the depredations of these animals. I had already noticed innumerable heaps of loose soil thrown up by these rodents everywhere at high altitudes from Mt. Damōta southwards. Each mole-rat excavates an irregular network of subterranean galleries covering many square yards. But nothing corresponding to a mole-hill indicates the position of the nest, which may be situated at almost any point, so that prolonged search for it may be needed.

As the peasants were snaring the animals in their burrows, I managed to bring back three skins, due to Negussie's skill as a taxidermist, but only two skulls, that of the third specimen having been seized by a kite while Negussie's back was momentarily turned. I had experienced the impertinence of these birds before, when at Debra Libanos (1927) my camp-cutlery was knocked off the table under my nose by a kite swooping to seize some fish-bones.

The genus *Tachyoryctes* is represented in eastern Africa by over 20 species and geographical races ranging from northern Ethiopia to Kivu and Kilimanjaro (Rode, 1945). The examples from Mt. Tola have been referred to a form originally discovered in districts west of the Gughé Highlands (*Tachyoryctes splendens omoensis*).

Commensal insects, etc.: many commensal organisms had been found in the nests of mole-rats on Mt. Elgon; those enumerated in fact comprise over 60 species, representing six Orders of insects, as well as pseudoscorpions, acarines and isopods. But, single-handed and more than fully occupied, I could not undertake a comparative investigation on Mt. Tola. Yet I regret this enforced omission, and hope that future collectors may devote attention to this interesting piece of ecology. As far as is known the commensals live concentrated in the mole-rat's nest, to which habitat they are restricted. They do not frequent the galleries haphazard, whereas many European species of *pholéophiles* seek refuge in winter in burrows, irrespective of whether their hosts be moles, rabbits, hamsters or other burrowing mammals (Jeannel, 1945, especially p. 11).

Remnants of wild vegetation in the valley: though I have tried above (p. 93) to outline the vegetation-zones in the Gughé Highlands, the small patches of wild growth left in the Bonghé valley and on the surrounding slopes merit further description.

In the valley, as in other parts of Gamo at about the same altitude (9,000 feet), the local people have (as was explained to me) a fondness for the giant *Lobelia giberroa*; groups (Pl. 16) or single plants stand near many houses, where they must either have been planted, or spared when the surrounding growth was cleared. Elsewhere (Mt. Zuquāla and Mt. Tola) I have found this lobelia under more natural conditions up to 10,000 feet; but its 'anthropophilous' nature and the influence of man on the vastness of its range—from at least as far north as Zuquāla in Ethiopia and the Imatong Mountains in the southern Sudan, to Tanganyika—has been stressed by Professor Hauman (1933, p. 12) and by Dr. Jeannel (1950, p. 216) Hauman rightly explains that a species needing neither dense forest, nor dry scrub, nor the rigours of the highest altitudes, has gained many sites suitable for its growth through man's clearing and cultivation of the soil. To which, in Gamo at least, may be added deliberate conservation of the plant by the people.

I have found *Lobelia giberroa* in flower from October to December. The group of these plants shown on Pl. 16 was surrounded by short grass full of low-growing lobelias. While extremes of form and habit within the same genus were here visible side by side, the delicate little bright blue flowers of the lowly representatives far excelled in beauty the dingy purple blossoms of their giant relatives.

The small patches of lower mountain-forest left on the steep slopes enclosing the valley perhaps owe their preservation to the ground on which they stand being venerated for some reason, like the forest-clad hill north of Chencha (p. 139). One such patch, visited 13 December, near the track leading down from Mt. Tola, consisted of large sombre-hued forest-trees (*Schefflera volkensii*, Araliaceae) with clusters of small green flowers, many creepers and epiphytes and some bamboo. Partial clearings were filled with a rank growth of brambles, jasmine, bush-*Hypericum* and other flowering bushes, a *Helichrysum* with white flower-heads, etc. Conifers were absent.

Vegetation on the mountains: the bamboo-subzone has, as on Mt. Damōta, been divided by clearing into separate groves and woods, some of them very extensive, though almost more trimly delimited by man than those farther north. They are usually enclosed in fences of plaited split bamboo, and confined to the least accessible places, steep sides of torrent-valleys or ravines below waterfalls (Pl. 18). Like other travellers on the African mountains, I have not seen bamboo in flower (cf. Jeannel, 1950, p. 203) but I imagine the woods to consist of *Arundinaria alpina*. In places the undergrowth, though low, is dense; for instance, on 25 December in the large woods west of Mt. Tola I noted a herbaceous species of *Alchemilla* (Pl. 19), not flowering (and unfortunately not collected), the little pale violet flowers of *Viola abyssinica*, a pink balsam and the deep blue flowers of the 'shamrock pea' (*Parochetus communis*).

In these same large woods the bamboo-foliage, especially the upper part, was brown and dead, giving the groves, as seen from a distance, a wintry look. I am at a loss to explain whether this was due to exceptionally severe weather or to a fungus or insect-pest. A single large weevil, found in a dead and decaying bamboo-stem, proves to be a species of *Pseudomesites* (sub-family Cossoninae), new to science and the largest member of its genus known. Sir Guy Marshall, to whom I am indebted for the identification, thinks it very unlikely that the *Pseudomesites* had caused this large-scale damage to the bamboo, and more probable that the presence of this specimen in the decaying stem was accidental (*Pseudomesites* normally attacks giant lobelias and senecios).

The slopes immediately round my high camp on Tola were cleared of forest and largely cultivated. But east and south of the camp, away from the potato-fields of the western slope, stretched grassy downs grazed by sheep and goats, with patches of a tall pink-flowered *Kalanchoë* (undetermined), brambles and other coarse plants in hollows, and isolated clumps of a fern (*Dryopteris* sp.), four feet or more across, in the short turf. A similar fern-clump, on Mt. Gughé itself, is shown in Pl. 19 (left foreground).

On the steep higher slopes the vegetation is that of the heath-zone, which mingles on the summits with plants of the high-mountain zone. Mt. Tola and Mt. Gughé, however, present local differences rendering them worthy of separate consideration.

Mt. Tola: the top, whither (15 December) I scrambled 1,500 feet or more up the very steep end of the long ridge, is a plateau sloping upwards towards the north, covered with stunted bushes of *Erica arborea* about four feet high, and a dense growth of alchemillas. These latter comprise the tall *Alchemilla haumannii* and two low-growing species. *A. haumannii* (*A. chillaloensis*; Pl. 18), which I had discovered on Mt. Chillālo in 1926, has stout, upright, woody stems several feet high and small silvery leaves; it is a beautiful plant, forming silver-grey patches visible on the mountain-tops from some miles away. According to Professor Hauman the two low-growing species are, respectively, a form of *A. gracilis* near the variety *palustris*, and a creeping herbaceous species, probably new though this is uncertain in the absence of flowers. Whether the alchemillas are woody-stemmed or herbaceous is of considerable interest, as Professor Hauman has divided the genus into groups of species and studied their relationships. The centre of dispersal of the woody species would appear to be Ruwenzori, which their ancestral stocks may have inhabited before the last Glacial (Hauman and Balle, 1934; Jeannel, 1950, pp. 218–9). I have only seen the mountain alchemillas in Ethiopia in November and December, when they are not flowering. It may be noted that the single species (*A. fischeri*) found on Mt. Damōta did not reappear on Mt. Tola.

On the top of Mt. Tola the *Erica arborea* was, as elsewhere, not in flower, but the tall *Hypericum*-bushes were covered with blossoms. Other plants comprised the purple *Swertia lovenii* (above, p. 144), pink-flowered *Bartsia petitiana*, a single spray of *Myosotis*, and the white-flowered *Hebenstretia dentata* (Selaginaceae, but superficially resembling a heath). Tufts of a wiry grass (*Festuca rigidula*) grew in more open spaces, and much *Helichrysum* (*H. formosissimum*, some with the outer bracts very deep red, others much paler, and *H. odoratissimum*, with clusters of very small yellow flower-heads). *Senecio schultzii* was flowering in wet spots.

Along the almost inaccessible craggy crest of the eastern escarpment, and there alone, I saw (but could not reach) a group of a giant *Echinops*, not very tall, but with immense leaves forming a rosette, having in its centre a single large white flower-head*. There also were young plants, a few feet high, of *Lobelia rhynchopetalum*, which had not yet flowered; in the only example which had (Pl. 18), the leaves were withered but stem and seed-capsules still green, and others found a week later on Mt. Gughé were in the same phase. This, the second Ethiopian species of giant lobelia, is confined to Ethiopia, flourishing at much higher altitudes than *Lobelia giberroa*; I have seen it on Mts. Chillālo, Tola and Gughé, and on the high ridge south of Baza (Bonghé).

Having only met with inflorescences of *Lobelia rhynchopetalum* in December, when the plants were fruiting and dying, I have never seen their bluish-green flowers. The traveller Wylde (1901, pp. 345–6) was greatly impressed by these plants in the northern province of Lasta, as well he might be; he gave the height of a large specimen as about 22 feet in all, allowing eight feet for the bare stem, six for the crown of sharp-pointed drooping leaves, and perhaps eight for the 'shaft' covered with flowers of eau-de-Nil colour. He noted also that boys used the hollow woody stems as trumpets (which I did not see done) and that the native name used there was *gevara*†.

Mt. Gughé: On 20 December I rode west from Mt. Tola for three hours to Mt. Gughé proper, by narrow paths through bamboo-woods and fields of young barley, accompanied only by Negussie and Ghidello on horseback and by porters carrying light baggage for two nights. Much necessary repair of the paths with mattocks and basketfuls of soil had been carried out by the peasants under the supervision of the *shūm*, Ato Gabré, but, though the three of us had sure-footed horses, bred to the hills, we were forced to dismount when crossing the steep-sided stony ravines between the mountain spurs. Near the foot of the twin peaks of Gughé, on the east side, I occupied an empty bamboo-walled grass-thatched house for two nights.

The vegetation of these twin peaks, in contrast to that on Tola, consists of close-grazed turf rather sparsely dotted with low bushes of *Erica arborea*, alchemillas of more than one species, and other plants. I collected four grasses (*Festuca rigidula*, *Aira caryophylla*, *Agrostis mildbraedii*, *Andropogon* sp.) and a rush (*Luzula abyssinica*). Two plants of the gentian family were abundant, the yellow-flowered *Sebaea schimperiana* and a small *Swertia* (a variety of *S. lugardae*), less than a foot high, with the outside of the petals blue-purple edged with white.

South-west of the twin peaks, however, stretches a vast moorland (Pl. 19) like that on top of Mt. Tola, covered with *Erica*-bushes, great silvery parterres of *Alchemilla haumannii*, and, in damp hollows, *Kniphofia* mixed with a large-leaved herbaceous alchemilla.

General nature of the mountain-tops: it is significant that the sloping table-land forming the top of Mt. Tola and that south-west of the peaks of Mt. Gughé are, like the top of Mt. Chillālo, covered with black peat-soil, presumably acid. Therein they resemble the corresponding zones of vegetation on the high mountains of East Africa.

Two important differences between the mountains of southern Ethiopia and of eastern Africa, both noteworthy, depend on the much lesser height of the South

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* Seen from a distance, these globe-thistles somewhat resembled *Echinops longifolius*, but the latter species has several globular heads on stalks rising from each rosette of leaves, and its flower-heads are purple; whereas the plants on Mt. Tola had only a single globular head, apparently sessile, and the flowers were white. I have not seen *E. longifolius* growing, but it is shown in the foreground of two of the curious old sketches (nos. 12 and 13) made in the Simien mountains by an anonymous German traveller who was held captive by the Negus Theodore. His drawings were described by Sophie F. F. Veitch and published in 1868, before the liberation of the artist and other captives by the British Army under Sir Robert Napier (Lord Napier of Magdala). Several of the old sketches also show tree-euphorbias, and nos. 10, 22 and 26 show giant lobelias in flower.

† At Sōddu (Wolāmo) my men told me that the *Dracaena*-tree is called *giberra*. Its crowns of leaves have rather the same appearance as those of the *Lobelia*. Are *gevara* and *giberra* two forms of the same name?

Ethiopian mountains. (i) *Absence of a zone above the rain-clouds* : I cannot say exactly at what altitude the greatest precipitation occurs, but I have been enveloped in cloud and soaked with driving rain on the top of Chillālo (between 12,000 and 13,000 feet, November 1926) ; again wrapped in cloud, which however gave way late in the afternoon to bright sunshine, on Tola ; and only by good fortune ascended the twin peaks of Gughé on a brilliant day (cf. p. 110). Therefore, though the maximum rainfall probably occurs below the summits, yet these fleeting experiences have convinced me that the massifs of southern Ethiopia have no zone permanently above the rain-clouds, where solar radiations of feeble wave-length penetrate progressively more as the altitude increases (Jeannel, 1950 *a*, p. 201). Yet some of the plants of their highest altitudes do present features believed to act as a protection against such radiations, for instance, thickness and tomentosity of the leaves, and persistence of hanging dead leaves forming a thick covering round the stem (this last feature is particularly evident in *Kniphofia*).

(ii) *No belt of vegetation above the limit of flowering plants* : similarly the South Ethiopian mountains are not high enough to have a top belt of vegetation where only cryptogamic plants can exist, as the highest East African mountains do. Stunted *Erica arborea*, mostly only three or four feet high, dense patches of *Alchemilla haumannii* and groups of *Lobelia rhynchopetalum*, with other flowering plants, cover their tops.

Mt. Chillālo compared with the Gughé mountains : though these mountains, more than 150 miles apart and on opposite sides of the Galla lakes, have many plants in common (witness those just mentioned), yet I could give a long list of flowers found on Chillālo (and on Zuquāla) in 1926, but not rediscovered during my brief visit to the Gughé heights. A few examples must suffice : *Anemone thomsonii*, *Arabis albida*, *Kniphofia thomsonii* (only about nine inches high), and three Iridaceae (*Moraea thomsonii*, *Hesperantha petitiana*, *Dierama pendula*, the last with delicately hanging mauve flowers), all found on Chillālo, were not seen in the Gughé mountains, though some of these may occur there in places which I could not visit.

The Helichrysums : several species of ' everlastings ' have been mentioned in describing particular places. The following brief list indicates the difference on the several mountains : on Mt. Zuquāla only *H. abyssinicum* was collected ; on Mt. Chillālo, *H. formosissimum*, *H. citrispinum*, *H. schimperi*, and certain undetermined species ; on Mt. Tola, *H. formosissimum*, *H. gulielmi*, *H. foetidum*, *H. argyranthum*, and two unidentified species. Only one named and one undetermined species were found on both Chillālo and the Gughé mountains (the undetermined species, probably new to science, has many small white flower-heads branching from slender stems, each rising from a rosette of tomentose leaves). In Africa this genus is most richly represented in the south ; the many species on the East African and Ethiopian mountains are believed to indicate a migration which has extended farther north than that of the *Philippia*-heaths mentioned below (Jeannel, 1950 *a*, p. 222).

The heaths : like other collectors, I have never found on the Ethiopian mountains any member of the predominantly South African genus *Philippia*, so characteristic of the heath-zone on the high mountains of East Africa. Yet I collected *Blaeria spicata*, also representative of a mainly South African genus, on Mt. Chillālo and again, in small quantity, at Ezo (see above, p. 138).

If the dispersal centre of both these genera has been in the south of the continent, then *Blaeria* has apparently travelled farther north than *Philippia*. As to *Erica arborea*, the dominant component of the heath-zone on Chillālo and the Gughé mountains, this plant, the white-flowered *bruyère* of the Atlantic Islands and North Africa, has apparently travelled in the opposite direction. It is believed to have extended its range southward to Ethiopia, Ruwenzori, and Mts. Elgon, Kenya and Kilimanjaro, as recently as the Pliocene (Jeannel, 1950 *a*, pp. 222, 221).

Some high-mountain insects, their distribution and habitats; possible agents in pollination of giant lobelias: the biogeographical relationships of some of the insects collected on these mountains are markedly parallel to those relationships in certain components of the mountain-flora. The following are a few instances, with the special *milieu* in which the insects were found.

Among the Carabid beetles a representative of *Trechus* (*s.str.*), discovered on Tola in damp humus at the roots of ferns and in the bamboo forest, proves to be a new species (*T. gugheensis* Jeannel, 1950 *b*, p. 177), distinct from any of the four which I discovered on Chillālo in 1926, and related to one inhabiting the high altitudes of Elgon. It constitutes another link in the series of species of this northern genus which have spread southwards, even beyond the Equator (cf. pp. 99–100).

In other cases, however, the same Carabid inhabits Chillālo and the Gughé Highlands, e.g. a member of the Bembidiine group (*Hypsipezum mus*), discovered on Chillālo in 1926, is abundant in the Gughé mountains, where 96 specimens were collected at the roots of *Erica arborea* and a smaller number at the roots of ferns, all on one day, on Mt. Gughé itself.

The genus *Calathus* is represented by distinct species on the several mountains. In 1926 I discovered one species on Zuquāla and three on Chillālo (Alluaud, 1937, pp. 275–80, figs. 1–5). None of these reappeared on the Gughé mountains, but two other species (both new to science) were numerous, especially among the seed-capsules of the dying *Lobelia rhynchopetalum* shown in Pl. 18, also at the roots of heath and among dead leaves of *Kniphofia*; they illustrate the attractiveness to insects of even a single inflorescence of a giant lobelia; after the stem was cut the inflorescence was immediately laid on a white waterproof sheet and searched, showing that the many insects found in it were already there while it was still standing.

Though on the high East African mountains the flowers of giant lobelias are sometimes rifled by sunbirds (*Nectarinia*), I learn from Professor Hauman that these birds are not, in his experience on Ruwenzori, numerous enough to be the sole agents in fertilizing the flowers. Again my experience confirms his. On the highest mountains in southern Ethiopia I have never seen any sunbirds (though they are common enough at Addis Ababa and elsewhere). On the other hand the insects frequenting the inflorescences are numerous in species and in individuals; they are not only Coleoptera (the lobelia-haunting species of which are in many cases flightless), but I also found the inflorescences of both *Lobelia giberroa* and *L. rhynchopetalum* harbouring quantities of caterpillars, possibly of a Noctuid moth, which I tried unsuccessfully to rear. So there should be no lack of insect pollinating agents.

Anillini: the bamboo woods and a small remnant of *Hagenia*-forest at 10,000 feet were the scene of a find perhaps the most interesting of all; namely, two representatives of this endogaeous tribe of Carabidae, living together in the soil. The biogeographical implications are discussed above (pp. 101–2). Like all members of the tribe, these two are very small (scarcely more than a millimetre long), pale yellowish from lack of pigment, and blind.

Though special apparatus is used for collecting Anillini in Europe, I simply threw handfuls of black humus, scraped from a depth of six or eight inches, into a metal sieve, whence I sifted it on to a white waterproof sheet. While the siftings dried in the (usually weak) sunlight the Anillini, emerging from the heap, were removed on a moist paint-brush to a small killing-tube. Beetles of other families were collected from the siftings at the same time, including certain Ptiliidae, smallest of all Coleoptera. Insects so minute would have been lost in the ordinary packing materials, and had to be preserved by appropriate methods immediately after return to my tent, no matter how cramped the space or how uneven the camp table which served as field laboratory.

Rhopalocera: throughout Ethiopia butterflies illustrate the contrast between highland insects and those of the middle and lower altitudes more readily than most groups, owing to their conspicuousness and their being better known. I have referred (p. 106) to the general faunistic study of those occurring above 1,500 metres (4,900 feet) by Professor Hale Carpenter (1935), and here mention only some characteristic highland butterflies met with on this journey as compared with my previous experiences.

Among butterflies of northern affinities, representatives of *Colias* (i.e. related to our Clouded Yellow) were abundant, as seems general in the highlands. Deep yellow and paler examples were flying near the summit of Mt. Gughé itself on 21 December. The occurrence of the large fritillary (*Argynnis hyperbius*) on mountain-tops has been mentioned. Though a representative form (*Lycaena phlaeas pseudophlaeas*) of the Small Copper is widespread in the highlands, I met with it only during my earlier journey. On the other hand the Ethiopian form (*Pontia daplidice aethiops*) of the Bath White was found even farther south than Gughé, on the grassy mountains north of Gardulla. The strongly migratory, now world-wide Painted Lady (*Vanessa cardui*) was very numerous in places, e.g. many specimens, freshly emerged, were on the wing in the Bonghé Valley, above 9,000 feet, on 30 December, despite dull weather.

As to species definitely ' exotic ' from the European standpoint : almost the only other butterfly seen on the high mountains in December was a small purplish-brown Lycaenid (*Cacyreus palemon ghimirra*) with complex markings on the underside ; this form, widespread in high Ethiopia, was plentiful but its habit of settling with closed wings on short turf made it difficult to see and capture. Butterflies of the African Nymphalid genus *Antanartia*, some species of which superficially resemble the Red Admiral (*Vanessa atalanta*), though smaller, were rarely seen. So I never quite recaptured my earliest impressions of entomologizing in Ethiopia when, during my first days in Jem-Jem Forest (September 1926), two species of *Antanartia* were fairly plentiful on bramble-blossoms (for names, see Carpenter, 1935, p. 372). These ' false Red Admirals ' visiting bramble recalled early autumn in Europe, just as the diversity and number of caterpillars shaken from foliage into a beating-umbrella could have made a newcomer imagine himself in a European wood in the month of June. I have elsewhere (1950, p. 157) noted this apparent confusion of the seasons, early summer and autumn seeming to synchronize ; a mingling reflected in the simultaneous blooming of wild rose (*Rosa abyssinica*), clematis (*C. simensis*), bush-*Hypericum* and bramble. That those first experiences were not repeated was mainly due to the difference in type of the country visited during my recent journey.

I am leaving aside the tropical butterflies (especially Pieridae) of the lower altitudes, some of which were still surprisingly abundant at particular spots, even in dry acacia-bush and when the Dry Season was in full swing.

BONGHÉ TO GHIDOLÉ (31 *December to* 4 *January*).

The town of Baza (9,500 feet) : finally descending from the high camp on Mt. Tola on 26 December, during a smart shower followed by a damp chilly evening, I camped again in the Bonghé valley, near the school. After three days with scarcely a gleam of sun, I rode on 30 December to Baza, where my camp was pitched inside the high bamboo stockade surrounding the District Government buildings. Fitaurari Katta, who was staying there in a great circular tukul, entertained me to a farewell supper, with a wood fire, most welcome on this very cold damp evening, burning on a large circular double-rimmed earthen hearth, nearly in the middle of the floor. Having not hitherto been invited to an evening meal, I was interested to see the room lighted by little torches of cotton stuff dipped in wax, held by serving-boys dressed in shorts and woollen pullovers, round which some of them had swathed their cotton *shammas*. I sat on a long seat draped with an oriental carpet, while the Fitaurari reclined on a low easy chair, consisting of a wooden framework with cross-strips of hide. I took leave of this courteous and helpful chief with regret.

Close to my tent was a fragrant red cultivated bush-rose (*Rosa damascena* ?) of a kind seen in several other remote places, together with multi-coloured garden-lupins and scarlet cannas. I was told that these beginnings of flower-gardening owed their origin to the Italians.

Earlier in the day (a Thursday, as at Ochollo, p. 141) a busy market had been held at Baza. Conspicuous products for sale were coils of scarlet-dyed cotton, sent down from Addis Ababa to be woven into the borders of *shammas*. Gallas from the Borāna country were selling grey rock-salt, which (it was emphasized) had been carried to Baza on oxen owing to the lack of mules. The following Tuesday (4 January) I again saw Borāna Gallas selling rock-salt at Ghidolé, but in that case it had been transported on camels. I met with no other instance of transport by oxen except that mentioned above; but a half-century earlier the Bòttego Expedition appears to have used oxen in some numbers, as well as mules and donkeys, for transport across the Gughé mountains.

The southern Gughé mountains; Baza to Algudi (31 *December and* 1 *January*): a ride of nearly eight hours, including halts, led southwards over a high ridge where alchemillas reappeared and the fitful sunlight glinted white off the swordlike leaves of *Lobelia rhynchopetalum*, many young plants of which were seen, but none in flower.

South of this ridge lies a forested region of almost precipitous-sided valleys and ranges, most beautiful but confusing, as they seem to be orientated in all directions. I fully understood how these highlands struck Père Azaïs and his colleague as more *tourmenté* even than Switzerland, a character which, combined with the luxuriance of the vegetation, left him unable to describe the landscape: 'mais ne décrit pas qui veut, car qui voudrait ne le peut pas' (A. & C., p. 264).

In these steep valleys, and in the better weather at length prevailing, the peasants were harvesting ripe barley (Pl. 20), not with sickles (cf. p. 142) but tearing it up by the roots, to avoid wasting the short straw. The small sheaves were laid on their sides in rows about three deep; usually two such ranks lay parallel, with the long-bearded ears facing inwards towards those of the opposite rank (Pl. 21), or two ranks were laid at a right angle with the ears hanging inwards; possibly this custom is intended to shelter the grain to some extent from sudden storms. Later the sheaves were piled in little ricks recalling those of the Scottish Highlands. Pl. 20 also shows sheep and humped cattle browsing in the stubble under the charge of a boy with a very long spear. Two immense sombre-foliaged *Podocarpus*-trees, bearded with lichen, are left standing in the field. The tall plumes of light green bamboo cover the steep ridge in the background.

New Year's Day (1949) was spent in camp at Algudi (over 9,000 feet), south of a broadly conical mountain dominating these southern confines of the Gughé Highlands. By a spring near at hand stood several tree-ferns of moderate height, the only ones seen on the whole journey*, together with many plants of the fern *Blechnum tabulare*, the long fronds of which rise from upright stocks about two feet high. Club-mosses luxuriated on the rocks, both *Lycopodium clavatum* (already found on the escarpment of Tola) and

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* These are the only tree-ferns I have ever seen in Ethiopia. Judging from certain geographical film-shows and published photographs, tree-ferns may be more common on the western slope of the highlands, at somewhat lower altitudes; see illustrations of the forests of Kaffa in Cerulli (vol. ii, pls. 5, 6); also the fine photograph in Cei and Pichi-Sermolli (1940, pl. 1) of tree-ferns in the forests of Kaffa, the particular form being determined by them as *Cyathea manniana* var. *deckenii*.

L. cernuum, the much-branched shoots of which simulate miniature pine-trees. But even about Algudi much wild growth was being grubbed up to make way for cultivation, as has happened farther north.

Descent from the Gughé Highlands: on 2 January, riding some five hours, I descended about 2,000 feet to Zaga, at about 7,000 feet. I regretted, soon after leaving Algudi, being unable to stay near some pieces of indescribably luxuriant mixed forest where, though the altitude was already low for bamboos (which were almost absent), *Lobelia giberroa* and *Euphorbia obovalifolia* (see p. 126) were growing in a dense tangle of forest-trees and creepers, among which the deep blue flower-spikes of *Acanthus eminens* climbed eight or ten feet high. In similar forest north of Algudi I had found on boggy ground a fine pink orchid (*Satyrium crassicaule*), not hitherto recorded from Ethiopia. Considerably lower, near the village of Garassé, was a small patch of large dark-leaved forest-trees (*Ilex mitis*), doubtless a remnant of the mixed mountain-forest zone (p. 91).

After this the montane zones were soon left behind for lower country covered with dry grass, where erosion has torn steep-sided gullies in the red earth and left strange formations standing. Little pink-flowered oldenlandias reappeared (cf. p. 126) and large clumps of scabious, pale pink rather than mauve, were flourishing in the red scoriaceous-looking soil. This eroded red earth landscape vividly recalled the pass between Seiyani and Ibb, at about the same altitude in the southern Yemen (Scott, 1942, p. 100).

Butterflies attracted to excreta of a carnivore: though tropical butterflies of several species in fresh condition swarmed on these southern slopes, they were not attracted by the innumerable droppings of the cattle grazing in the open scrub. But at one point lay the faeces, full of wool or hair, of a carnivore, at first attributed by my men to a leopard, though Negussie, probably with more knowledge, was positive that they were those of a civet. These excreta attracted hundreds of a small orange-brown and black-marked *Acraea* (*A. bonasia banka*), also a few Long-tailed Blues (*Lampides boeticus*). Examples of a small Satyrine butterfly flying nearby showed no tendency to visit the excreta.

The connecting range: the gap between the southern spurs of the Gughé mountains and the massif north of Gardulla is crossed by a relatively low, narrow winding range (*une dorsale*). On 3 January, keeping compactly together for safety as the tract is uninhabited, we wound up and down along the top of this chain, skirting the sides of rounded mountains a little below their summits, and crossing ridge-ways between them so narrow that we could only proceed in single file. The very steep sides of the ridges are covered with long brown grass sparsely dotted with bushes and small trees, especially *Protea*-trees (bearing only dry dead remains of flowers). Below the range to the west, farther than eye could reach, extended a plain of dry grass and bush.

The massif north of Gardulla: quite different in aspect from the Gughé mountains are those of the southern massif, along the steep grassy sides of which we rode till cultivation appeared again. The path lay through several sharply delimited patches of forest, dense jungles of forest-trees, lofty euphorbias and wild date-palms, over which sprawled creepers, some (I was told) yielding rubber. Here and there the forest paths were perfumed by the heavy fragrance from overhanging sprays of white jasmine (a broad-leaved species, probably *Jasminum abyssinicum*), while many other flowering bushes and herbs, unknown to me, and large tropical butterflies (*Papilio*, *Acraea*, etc.) also witnessed to nature's exuberance. The long ride of eight hours from Zaga ended at a beautiful camping-ground where two tracks forked.

Ghidolé was reached next day (4 January) by a ride of two hours and a half over a very steep grassy mountain ridge. This deviation from the main route led to my seeing a surprising number of lofty wild date-palms. Fairly plentiful in the lower country south of the Gughé mountains, scattered in forest and over open ground, these trees are either single-stemmed or form clumps with several stems. At one point a dense natural grove (Pl. 21) lies in a moist hollow, mixed with only a few forest-trees and surrounded by green grass and cultivation. The altitude is over 7,000 feet, the species probably *Phoenix abyssinica*; at any rate it is not *P. dactylifera*, nor could I learn that any use is made of these wild palms*. The deep red-purple pea-flowers (*Tephrosia interrupta*), previously found on Mt. Damōta (p. 134) but not since, were also abundant.

GHIDOLÉ (4–8 *January*).

This town, which the Governor of Gamo-Gofa Province had recently made his capital, is situated east of Gardulla airfield, at about 5,000 feet, overlooking Lake Chamo, which lies some eight miles to the north. Government buildings erected by the Italians, though now dilapidated, were occupied by the Governor, Dajazmach Garāsu Duké. This extremely tall and powerfully-built chief was one who never laid down arms during the years of Italian occupation; he recounted to me (through Negussie) how on one occasion he and his forces had continued fighting in the forest for five days and nights on end. His health had evidently suffered; he was strictly dieted under the orders of a solitary Italian doctor, who sat beside him at each meal to which we were invited.

(The doctor, who had been the only European in Ghidolé for between two and three years, apologized for not inviting me to his house, owing to the rather primitive style in which he had to live. He could rarely leave his post to visit Addis Ababa, while no hospital or medical colleagues were then situated within a very long distance. Medical supplies were not easily got, and he was often exposed to the risk of malaria when his duties led him to pass several nights near lake-level. He therefore readily accepted as much paludrine as I could spare in return for a small professional service.)

The Governor, though officially a Dajazmach, had previously, as a popular hero, been styled ‘ Ras ’. Under that style he is shown leading his army across the Omo River in a photograph illustrating the official account of the campaign (*Abyssinian Campaigns*, 1942, p. 134), a copy of which, opened at this illustration, lay before him on the table at my first interview. Being uncertain whether the pamphlet was in fact the official narrative, I ventured, while the Dajazmach was talking to Negussie, to lift the pages and read the title on the wrapper. But my action did not escape the Dajazmach who, doubling back the pages so that the photograph of himself lay uppermost, brought his strong fist down on the pamphlet and held it there. To my surprise, I found him and other high chiefs unwilling to be photographed.

Dajazmach Garāsu's reputation for not favouring Europeans seemed at first to be confirmed for, when I called to pay my respects on the first evening, I was kept standing for some time at the outer gate of his residence, and finally refused admission. But the following morning I, Negussie and Salomon (the hospital dresser) were most courteously received, and later were lavishly entertained by the Dajazmach. But he could not provide mules to take us directly eastward to Agheré-Maryam. There being, in fact, scarcely a mule to be seen in Ghidolé, the Governor was evidently hard put to it to find any means of transport for us at all, so that I must needs accept his offer to squeeze us and our belongings into an already fully loaded lorry of his own, due to leave for the frontier of Kenya on 8 January. Thus we must travel a long way south-east to Yavello, where we should find motor transport northwards through Sidāmo to Dilla.

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* Vannutelli e Citerni (1899, p. 275) mention great numbers of *palme dattilifere* seen during the descent from the northern part of the Gughé highlands towards the Mazé river. Probably these palms were of the same species as those which I saw at a corresponding altitude south of the mountains. I have recently (March 1952) learnt from the Rev. A. F. Matthew that a soft matting, easy to roll up, is made from the leaves of more than one species of *Phoenix*, also from those of *Borassus*; the Amharic word *salēn* means primarily a palm-tree, but ordinary people understand by this word ‘ matting ’, even such as is made from other plants besides palms. Baskets and a kind of haversack are made of this matting. Bodies were formerly wound in it for burial, and this is still done when a coffin is not available. Mr. Matthew inquired not only from his personal servant in Addis Ababa, but from a missionary in the south, in Gamo-Gofa Province. The latter bore out that these wild palms are preserved only for the utilitarian reason that they furnish material for mats and other objects.

Having already (p. 142) had to abandon the plan of crossing ' God's Bridge ' and passing the northern end of the *Amāro Mountains* on my way to the main route through Sidāmo, I had now to give up going due eastward through Burgi, or north-eastward across the southern part of the Amāro Range. But Fitaurari Tadessa of Konso afterwards told me that no mule track to Agheré-Maryam exists, either across or round the southern end of the range, but only mountain footpaths, which seemed true, judging from the absence of mule caravans and from what I could see with field-glasses. In November heavy clouds had obscured the summits and blurred the outlines but, after I left Chencha in clearer weather on 2 December, the jagged crests, rising above 11,800 feet in Mt. Delo, often stood out sharply. From a distance both the west side of this range and its east side (seen later) looked steep and forbidding, covered with brown grass and scrub, with no sign of cultivation or real forest. The Amāro mountain-sides are said to be given up to cattle grazing.

Ghidolé market : on the day (a Tuesday) of our arrival, a large and crowded market was in progress. People of the Ghidolé tribes, Nilotic Negroes, mingled with various other racial types, including women with many brass bracelets on their arms, and some with their hair in long hanging plaits. Among the men were fine-featured Gallas from the Borāna country, usually with a rag bound turban-wise round the head, who had travelled hither bringing rock-salt on camels, not on oxen as at Baza (p. 154) ; these partial nomads had erected little temporary booths covered with hides, against which they leant their spears.

Butterflies at Ghidolé : the five hot, hazy days of our stay included the Ethiopian Christmas (7 January), a public holiday. Being under close surveillance by my men, in case of a further summons to the Governor's house, I only once eluded their watchfulness for an hour, descending a steep, narrow path between hedges of pink-flowered *Acanthus arboreus* to a stream flowing between low earthen cliffs, in a hot ravine where women were washing clothes. Here tropical butterflies were sailing to and fro, among them several specimens of *Charaxes etheocles* swiftly chasing one another, but occasionally settling on the topmost leaves of tall bushes, usually out of reach. This rather small, nearly black *Charaxes* is less impressive than the large handsome *Charaxes varanes* seen farther north in 1926–7, specimens of which eluded me through their strong flight almost till the end of the journey.

Oil-yielding cabbage seed : at Ghidolé I took seed from a dried-up but still standing crop which my men called ' one-month cabbage ', grown for the oil expressed from its seeds. The latter germinated easily at Henley-on-Thames during the hot summer (1949) after my return, when the cabbage proved to be *Brassica integrifolia* var. *carinata*, a long-cultivated plant, the original home of which is uncertain, though earlier records of it are mainly from Ethiopia. During the Second World-war it flourished on top of a dugout shelter in Chelsea, as an escape from the nearby Chelsea Physic Garden (Druce and Sandwith, 1941).

GHIDOLÉ TO YAVELLO (8–11 *January*).

This journey of about 117 miles is treated in one section, though it was accomplished in two pieces, mostly at night, with two days spent at Konso between. I deal with Konso separately, below.

The whole transit was made in one of Dajazmach Garāsu's large lorries, already laden with many passengers and a full cargo of merchandise for the Kenya frontier-post of Moyalé (whence a load of tyres was to be brought back to Ghidolé). As far as Konso I shared the front seat beside the driver, with Fitaurari Tadessa (brother-in-law of Dajazmach Garāsu), his wife and little daughter; the Fitaurari was returning to Konso, of which district he was Chief. At these comparatively low altitudes night travel is preferred, and the lorry is drawn up during the day in the shade to avoid exposing the tyres to the sun.

We left Ghidolé on 8 January about 4 p.m. and covered the 45 miles to Konso by 11 p.m. The route first led several miles west of Ghidolé to Gardulla airfield, winding down from the mountains by hair-pin bends, between fields of tall green *Sorghum* (*dhurra, mashilla*). In some places this crop was already bound in sheaves, while still growing, and naked boys mounted on raised platforms were scaring away the birds. Careful driving alone saved us from being pitched down a ravine, when the wheels on the outer side sank deeply into a stream-bed at a bend, and the dangerously tilted vehicle had to be emptied and dug out. After the descent the track lay east of south, through dry thorn-scrub, traversing running streams and dry river-beds.

The further 72 miles from Konso to Yavello lasted from 4 p.m. on 10 January to 10.30 a.m. on 11 January. The descent from Konso to the bed of the Sagan River (below 4,000 feet) lies through grim, almost barren mountains, with dry thorn-scrub and succulent euphorbias of low-altitude species, only of bush-height. The scrub, however, was not in its grimmest, quite leafless stage, for many small trees were putting out young green leaves, and an almost leafless leguminous plant (*Caesalpinia* sp.) displayed occasional large yellow flowers. Among these mountains we were again delayed nearly an hour, as dusk fell, by the discovery that some skins full of honey were leaking; half the contents of the lorry had to be unloaded before the trickle of sticky fluid could be stopped.

After crossing the nearly dry bed of the Sagan (where, as stated on p. 117, an escort of many foot-police awaited us), much ordinary scrub of flat-topped acacias and associated plants was traversed, till we halted in the early morning. Lying on the ground in the open steppe from 3 to 6 a.m., we felt the coldness of a high easterly wind after the oppressive heat of Konso and the Sagan valley.

During the long night-hours spent trundling through the bush, my only occupation was watching the fantastic appearances (recalling stage scenery) assumed by the vegetation when illumined by the headlights, and the birds and beasts on the track. Among the mammals were several jackals and large cats (probably servals), fennec-foxes, many hares and a very small antelope. The birds comprised a small species of bustard; others, probably sand-grouse, roosting on the ground in pairs; and large birds with white markings, which would flit to and fro across the track for a long time, as though unable to escape from the glare, but always keeping just too far ahead to be clearly seen—almost certainly some form of nightjar (*Caprimulgus*).

KONSO.

This amazing place, where I spent two days (9 and 10 January), indeed merits description.

The Konso are Nilotic Negroes related to those of Ghidolé and Gardulla, but great builders of dry stone-walling. Two of their towns or villages, an upper and a lower, which I saw (and there are others*) are surrounded by massive outer walls of unmortared masonry, unequal in height. Some parts are quite 10 feet high, if not more; moreover, these walls are (as I noted) very thick, according to Père Azaïs as much as four metres (13 feet); he also speaks of a double circumvallation of one village, which I did not note (A. & C., p. 250).

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* The *Guida* (p. 554) gives the administrative centre as *Giarso*, the tribal district as *Conso*. Fitaurari Tadessa appeared to regard the two names as synonymous, embracing a whole group (perhaps ten) of walled villages.

Within these outer defences the upper village at any rate, the only one which I entered, is divided into 'quarters' by other high and massive walls. The 'streets' are a maze, each one so narrow that a person must stand aside to let another pass, and each bounded by low stone walls some two feet high. Every 'quarter' is sub-divided into groups of circular houses, with low stone walls and high-pitched conical thatched roofs, the latter sometimes with an outer cap at the apex. These clusters of houses, with their granaries and other dependent structures, are separated by the low walls bounding the streets, or by stockades of massive upright wooden balks.

Just within each gateway in the outer wall is usually a house with a large section of its circumference, facing the 'street', open (Pl. 22), the roof being there supported on posts. These buildings are not private houses; they may serve as resting-places for wayfarers, but more probably as meeting-houses for the elders of each quarter (like the sectional meeting-houses of the Darasa tribe mentioned below, which, though built of different materials, also have the sides partly open).

Stone-terraced fields: near these villages the heads and sides of shallow valleys are terraced (Pl. 22). Even in the grim mountains to the east, some miles from the settlements, isolated patches of terraced cultivation exist, with no visible dwellings near at hand. The stone terrace-walls are most ingeniously constructed, but none which I saw were very high; even the highest were lower than many of the terraces in South-West Arabia, nor is the system of terraces, as a whole, on the great scale of that in the latter country (even in Ethiopia terracing seems to be developed on a bigger scale in the northern part of the immense eastern escarpment, e.g. near Mai Chaw; see Buxton, 1949, pl. 55 and p. 118).

Thus, by stubborn labour in the past, by building up the soil and keeping the terraces in repair, the Konso have made an agricultural country out of rocky, waterless hills. Even if ploughs could be used in the confined space of their terraced fields (as is done in South-West Arabia), the Konso have none, but use only hand-tools. Natural pasture appears to be non-existent, and few or no domestic animals were visible. (Bee-keeping is practised, for I saw hives of the ordinary cylindrical form high up in some tall acacias).

In January the terraced fields were full of cotton-plants in boll, with dead dry stubs of inter-planted *Sorghum*. Though I saw only one person, a woman, in the act of picking cotton, groups of people carrying cotton bolls filed past my camp. In the upper village little looms stood here and there; weaving, which I did not see in progress, is said to be mainly done by men, while women devote themselves to spinning, also boys, some of whom (quite naked) were engaged in this task. A man with a heavy club was beating white powder into a thick fabric, folded on a flat stone. I owe to the Rev. W. A. Ohman the information that the powder used in this whitening process is ground pumice-stone, not lime or other calcareous substance.

Basaltic upright stones: all the brown masonry of Konso looked basaltic. The stones placed as irregular steps in the narrow streets are polished by the feet of generations. Groups of three or more erect stones, up to about four feet high (Pl. 23) stand in little open public spaces; their sharp edges proclaim them sections of natural basaltic columns, examples of which, irregular in form and lying nearly horizontal, I had passed in the southern part of the Gughé mountains.

Negussie, questioning a few people who understood Galla, said vaguely that these upright stones were memorials to the dead. The stones are not themselves phallic in form, but similar basaltic columns are placed near some of the crude wooden statues on Konso graves, in which the phallus is a prominent emblem. These statues are not, as far as I saw, placed in the villages but in cemeteries at some distance, which I could not visit; but the fine photographs taken by Azaïs and Chambard prove that basaltic columns are in some cases associated with the statues (A. & C., pp. 249–56, pls. 81–88; especially pl. 83, fig. 1; 84, fig. 1; 86, figs. 1, 2; 87, fig. 1).

Under this reference will also be found several other aspects of life among the pagan Konso, which I could not investigate in a two-day visit. Such are their dress and ornaments, their strange yet strict matrimonial customs, their manufacture of pottery and their manner of lifting water from deep wells by a living ladder of women seated on projections of the well walls.

The Konso country: the brown tones of the arid landscape were relieved only by the pink blooms of swollen-stemmed *Adenium*-bushes, none higher than four to six feet, dotted here and there on dry, stony slopes. Besides being covered with pink trumpet-shaped flowers (so far as the colour went, they might from a distance have been taken for oleanders), these bushes were putting forth some young green leaves.

Even had much insect-collecting been possible, I should only have expected to find at that altitude (4,000 feet) widely-distributed drought-resisting forms. The only butterfly seen was the neutral-toned dry-season form of *Hamanumida daedalus*. My tent was invaded by a column of ants of a species (*Monomorium* (*Xeromyrmex*) *bicolor*) characteristic of the environment; these ants, attracted by some biscuits tightly shut in a tin, got curiously entangled in the rough woollen fabric of an army blanket on (but not under, at Konso) which I lay.

My tent was pitched in an enclosure with low stone walls topped by a stockade. The thatched house and dependent buildings occupied by Fitaurari Tadessa were enclosed in similar high barriers near by. A circular thatched church stood a little way off.

Tej and talla—but not qāt: the Fitaurari, though chief of Konso district, was himself a Galla. In token of his racial kinship with Negussie he sent twelve bottles of *tej* and *talla* (mead and beer) to my tent, ostensibly as a present to me. Having for courtesy's sake drunk a little *tej* and surreptitiously emptied the remaining contents of that bottle into the ground, I had to pass the other eleven bottles on to my men. As remarked elsewhere we were all feeling the abrupt transition from Mt. Tola to country 6,000 feet lower, and what with the heat (97° F. in the shade) and the liquor, they all slept heavily through the afternoon. Later Ghidello reappeared, maudlin and argumentative. Even Negussie, whose head was much stronger, forcibly reminded me that he 'knew the customs of his own country'. It was not an agreeable predicament, and I, in return, reminded Ghidello that I was alone among them (the Europeans who later received me at Dilla were nearly 200 miles away, and no others were much nearer).

These middle-aged French-speaking men on the whole worked hard, and did not complain of the discomfort in the mountains, which was considerable even by their own simple standards and despite the provision of ample bedding. For instance, Negussie once (unknown to me till the next day) lay all night without cover in the rain on Mt. Tola, guarding some baggage which the surly *nagadi* at the last moment refused to bring down. The subsequent lapses from sobriety were understandable, even if their behaviour in this particular compared unfavourably with that of the strict Muslims who accompanied me from Aden to the Yemen in 1937–8.

On the other hand, these men who occasionally drank too much had no addiction to chewing *qāt*. The only people on this journey whom I remember chewing *qāt* were the Arab chauffeur of the lorry in which I travelled a few days later from Yavello to Dilla and his mechanic. The *qāt*-tree (*Catha edulis*), native of rather high altitudes in eastern Africa, is believed to have been introduced into Arabia from Ethiopia. In my experience the custom of chewing its leaves is far less common in its native land than in South-West Arabia, where the deleterious results of carrying this practice to excess are all too familiar (I have briefly discussed the effect of the alkaloid drugs in the plant, 1942, pp. 94–5). Moreover, as I saw no plantations of the tree, my chauffeur's bunch of twigs and leaves may have been brought from the Harar district to Yavello (see postscript, p. 188).

YAVELLO (11–13 *January*).

In the approach to Yavello from Konso, the track ascends from arid steppe to about 6,000 feet. In a pleasant landscape, with mountains somewhat above that figure but not very lofty, the higher parts of the hills are covered with a thin forest of juniper, while the lower slopes, especially to the west, bear many wild olives. Huge crags and boulders stand out on the wooded slopes; bare rocks superficially resembling dolomite but, in fact, crystalline.

Chimney-like termitaria: in the night we had passed many turritiform termitaria of red earth, standing (as far as I could judge) at approximately regular intervals on the steppe, and recalling factory chimneys. Many similar termites' nests are also seen in the broad shallow valley where Yavello town is situated, but they were not met with in any other part of the journey. Termitaria of this form abound in the Turkana desert of northern Kenya, west of Lake Rudolf; photographs are given by Dr. Jeannel, who has also remarked on their resemblance to factory chimneys, and according to whom they may reach over 45 feet in height (I saw none so high; but see Jeannel, 1934, p. 76, pls. 25–27). Possibly the termites building those in the Turkana and about Yavello are identical or nearly related*.

Yavello market: on 11 January (a Tuesday) a market was in progress on a large rectangular space surrounded by ranges of low buildings erected under the Italian régime. These shops have neither corrugated iron nor regular thatch, but red sandy earth is spread over their roofs.

The Borāna people, as I saw from this gathering, have the fine features and almost mahogany-brown complexion of the Galla. Some persons whom I saw had eyes of the oblique mongolic-looking type mentioned above (p. 127); evidently this is a recognized characteristic of the Borāna (*Guida*, p. 562). Pastoral and less warlike than the Arussi, these people have been described (Sclater, 1899) as ' a race of pacific shepherds speaking a Galla tongue '. Though usually pagans, the men wear turbans, amounting in the case of camel-men and the like only to a wisp of rag bound round the head, leaving the crown bare, while men of more substance wear full turbans like those of the southern Arabs. (Negussie's linguistic difficulties were over; he was back among people speaking a form of the Galla tongue.)

Such camels as I saw were very light-coloured, almost white. The partly nomadic habits of the people are indicated by their erection of temporary hide-covered booths (as at Ghidolé market); moreover, shallow utensils of dark earthenware on sale at Yavello (without ornament, thereby differing from the ware in Wolāmo and Gamo) are furnished with a projecting handle, and these probably serve to scoop water up at water-holes in the semi-desert Borāna country.

The women at Yavello market (Pl. 23) wore dark red leather dresses, rendered supple by plentiful greasing. Some bore on their backs a large circular brass plate with a central boss, like the plate hung from horses' bridles in parts of

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* The species which constructs the chimney-termitaria in Turkana was described by Grassé in 1937 (*Bull. Soc. ent. France*, **42**, p. 71) as *Bellicositermes jeanneli*; see also Jeannel, 1942, p. 104.

Ethiopia. Their arms were loaded with brass bracelets, their necks with collars and necklaces of beads, the nature of which I could not note, as the wearers were rather camera-shy; but Colonel Curle, who on a recent journey saw these necklaces at close quarters, tells me that the beads are of aluminium, made locally from old imported cooking-vessels. As far as he has seen, the cowrie shells imported by the Borāna from the Kenya coast are used to ornament food-vessels and other utensils, but not for personal adornment.

Pl. 24 illustrates how strikingly physiognomy, dress and coiffure may change in a relatively short distance. The women shown, presumably members of a tribe of the Jem-Jem (Giamgiam) racial group, were surreptitiously photographed at Mt. Jabasirri, about 60 miles north of Yavello.

Yavello to Dilla (13–15 *January*).

Most of 12 January was spent negotiating at Yavello with Arabs for transport. Eventually we chartered a Ford lorry but, though Negussie did his best, the price demanded for a day's halt was so heavy that I had to agree to travel to Dilla without stopping except at night. So for three days I was hurried over some 125 miles of country, much of it very beautiful, the nature of which can only be outlined. Even so, it was interesting.

On leaving Yavello, after a long passage through dry grass and scrub, at first nearly flat, then gently undulating, the monotony of which was relieved by lively little ground-squirrels (*Xerus* sp.) running hither and thither beside the route, the road rises to the level of coniferous forest. For several miles it traverses the Magādo Forest, composed mainly of huge and lofty *Podocarpus*, festooned with long wisps of lichen, with smaller trees (unknown to me) intermixed. This forest, the greatest length of which from north to south is much longer than the tract intersected by the road, has the irregular edges and other marks of true primeval forest. Near at hand the great trees almost overwhelm the beholder by their height and sombre colouring; yet at a distance the woods and open glades, combined with the gentle outlines of the hills, recalled English woodlands. But a troop of *totas* and a band of *jinjeros* (*Cercopithecus*-monkeys and baboons) recalled me to where I was; while the state of the soil and the shrivelled condition of the epiphytes bore witness to the Dry Season here in full swing.

Wide extent and variety of forests in Sidāmo: the amount of forest remaining in the southern part of the province is indeed impressive. Forest country extends about 50 miles from the Magādo Forest, some way south of Agheré-Maryam, to Fasaganat. Between those two places I passed through a remarkable sequence of forests during nine hours' travel on 14 January. The rocky road, which leads up and down over steep hills, first descends into thick forest of flat-topped acacias with great wild figs here and there in grassy valley-bottoms and a little sparse juniper. This type was followed by dense, very dry forest of rather low trees, mainly wild olives and unidentified trees with dark leathery leaves, while *Podocarpus* again clothes the higher levels.

After about three hours came a long ascent into an expanse of dry grass and small *Protea*-trees (cf. pp. 134, 155), then the track rounded the west side of Jabasirri*, an isolated, abrupt, conical mountain (it is level with the northern part of Lake Chamo, but this is hidden by the intervening Amāro Mountains; north of that sharply serrated range is a fine prospect of the southern end of Lake Abaya).

Some hours farther north the road descends to very luxuriant moist tropical forest (Pl. 40) by a clear stream (doubtless a tributary of the Galana, running west to Lake Abaya); a rich mixture of dicotyledonous trees, varied by dracaenas and wild date-palms, and perfumed by the broad-leaved jasmine;

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* Giabasirrè in Italian transliteration; the Arab chauffeur called it 'Jebel Sirri'.

a counterpart of the mixed forest west of the lakes, south of the Gughé mountains.

Still farther north we were up again among extensive *Podocarpus* forests (Pl. 24), but clearings planted with *enseté*-trees began to appear. Houses were few and far between in all this forest country. Camel-caravans passed us, going south.

These hills of Sidāmo are indeed rich and beautiful. Their great expanses of forest display almost every imaginable shade of verdure, from the nearly black-green of *Podocarpus* to the light, almost yellow-green of bamboo, varied by the dull bluish nuance of euphorbias and emerald patches of *enseté*. The contrasts in tone are often sharp.

Transition to coffee-country: on the last day, 15 January (seven hours' jolting over a road, metalled in truth, but with large sharp stones), *enseté* and coffee plantations and other crops became more and more frequent. At length the forest is reduced to occasional clumps and single large trees left standing among the plantations. While increased cultivation doubtless makes for greater immediate prosperity, yet deforestation is rapidly becoming as complete as in Gamo. It is to be hoped that the Ethiopian Government will enforce some measure of conservation before it is too late.

South of Wonāgo (a village about five miles south of Dilla) the almost continuous coffee plantations are shaded by lofty leguminous trees (*Erythrina* sp.), all ablaze in mid-January with large orange-yellow flowers. The flower spikes project horizontally from the leafless upper branches and, with the unopened blackish-looking buds at the apex, grotesquely resemble the head and beak of a bright-plumaged bird ; the lower parts of the trees bear leaves with three broad lobes. I had seen a few of these Erythrinas in open country west of Lake Chamo, but here in Sidāmo they must surely be planted or at least encouraged as shade-trees for the coffee, as is the *madre de cacao* (*Erythrina umbrosa*) in the cacao plantations of Trinidad. Excepting the differently coloured flowers the scene vividly recalled the *madre de cacao* trees with their vermilion blossoms on leafless boughs*.

My men had noticed coffee-trees the preceding day, growing wild in the tropical forest south of Fasaganat ; for all the coffee planted in this part of Sidāmo is of the local wild form, that is, like other strains of coffee planted in Ethiopia, a form of *Coffea arabica*. According to the *Guida* (p. 95), there are four strains : (i) the Harar strain, cultivated round Harar, in the Chercher district and about Irgalam (Dallé) ; it has large 'beans' and is liable to be confused with so-called Mocha coffee ; (ii) the Ennāria form, grown in the west (Jimma, Kaffa, Limmu Ennāria, about Goré, etc.) ; (iii) the Zeghié form, from the north, about Lake Tana and in Gojjam ; (iv) the Ghenfiel form, from Wollo, north-east of the capital.

The coffee of Sidāmo should fall under the first head. But Azaïs and Chambard noted a difference in rate of growth between it and the Harar coffee. The Sidāmo coffee (they wrote), when irrigated and given what little cultivation it requires, bears fruit from its first year ; left to itself it needs three years ; while at Harar an average of six years must be allowed. These authors attributed the difference to the more southern latitude of Sidāmo (A. & C., pp. 219, 223).

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* The identity of the *Erythrina* so abundant in Sidāmo is uncertain. It resembles *E. ovalifolia* which, however, according to an illustration shown me has crimson, not orange, flowers. Of the allied species in Trinidad, Charles Kingsley wrote (1871) : 'Bois immortels, fifty or sixty feet high, one blaze of vermilion against the blue sky. Those who have stood under a Lombardy poplar in early spring, and looked up at its buds and twigs, showing like pink coral against the blue sky . . . . can imagine faintly—but only faintly—the beauty of these *Madres de Cacao*'. (At Last : a Christmas in the West Indies, chap. vii.)

Meeting-houses of the Darāsa tribes: the coffee-country just described lies in the territory of the Darāsa, a part of the eastern Sidāma racial group, but strongly influenced by the Galla in their tribal organization (*Guida*, p. 560). Though I saw little of the tribesmen in my rapid passage, the meeting-houses of the elders of their tribal sections are situated beside the road every half-mile or so. Each meeting-house is a neat circular tukul with walls constructed apparently of bamboo slats (though no bamboo grows close at hand, but in the hills to the east); each has a door towards the road, and also part of the back wall, open; each stands on an irregularly shaped lawn of short turf, on which stools and benches are placed (houses at Konso with one side open, perhaps serving the same purpose, are mentioned above, p. 159).

DILLA (15–26 *January*).

Dilla lies a little over 5,000 feet above sea-level, east of the north end of Lake Abaya, whence it is separated by some 15 miles of gently undulating scrub-covered country. This modern Ethiopian town, with broad red-earth streets and rows of one-storey buildings with corrugated iron roofs projecting veranda-wise, is an important centre whence local produce is despatched on lorries to Addis Ababa. A little removed from the main roads stand groups of thatched houses, one of which during my stay went up in a quick blaze, though fortunately the flames did not spread.

Here I awaited an answer from one of the English police-officers in the Ethiopian service, stationed at Irgalam, capital of Sidāmo. We had previously arranged to visit together the high country north-east of Dilla, near Agheré-Salam. That our plan miscarried was no fault of his or mine. He was called away from his centre (as I learned later) by urgent matters while I, receiving grave news from home in the first letters to reach me for nearly five weeks, abandoned the remainder of my programme and left for Addis Ababa.

Meanwhile my stay was not wasted. I was hospitably received in their house by a Belgian lady and gentleman, Monsieur Justin Van Billoen and his wife. As local Agent of the Addis Ababa house of A. Besse (Ethiopia), he received quantities of hides and coffee, brought in from the country on mules and donkeys for despatch to the capital. Any scraps left after preparation of the hides were simply placed in the evening at the gate of the large yard, whence they were promptly removed by hyenas. Several vultures were usually perched on the ridges of the iron roof; after a flight each would alight with a loud thump and descend the ridge in several minor bounces before coming to rest.

Festival of Timkot: a modern water-mill with turbines had been erected, originally by a Greek, outside the town and grain of *teff*, brought in by cultivators, was being poured into the machine amid a crowd of spectators on the day before *Timkot* (Epiphany); a public holiday and one of the greatest festivals of the Ethiopian Church. On the evening of 18 January the local clergy and *debteras* (lay singers) went to the stream in the valley near the mill to conduct the all-night services, and the sprinkling of the assembled people next morning. At this latter ceremony two priests carried on their heads the *tabots*, boxes or slabs of wood covered with embroidered veils, traditionally representing the Ark of the Covenant; sacred objects rarely taken outside the churches. *Timkot* was followed on 20 January by the festival of Mikhail (St. Michael).

In 1927 I had attended the Timkot ceremonies on a much larger scale at Addis Ababa, but the local celebration at Dilla afforded my sole glimpse of a Coptic religious service on the recent journey. In 1926–7 I prolonged my stay in Ethiopia to study ecclesiastical customs. But in 1948–9 my route lay through country where churches are far apart and not always easy to reach; even Fitaurari Katta of Bonghé, though accustomed to swift riding, had to leave his district centre for two nights to attend the feast of St. Gabriel (28 December) at a church dedicated to that Archangel, only accessible by a long ride over the mountains.

The *coffee harvest* was at its height and every available mule and donkey was wanted to carry sacks of the precious red berries into Dilla. Even the experienced Negussie found it next to impossible to hire mules*. Consequently I horrified my men by making short excursions on foot, despite the considerable heat; in particular, to a hot spring.

A hot spring (*and comparison with one in South-West Arabia*) : excepting the thermal bathing establishment in the lower part of Addis Ababa, where the natural openings of the spring are inaccessible, my only chance to visit one of the many hot springs in the country fell at Dilla ; others comparatively near my route, such as a spring south-east of Sōddu, were just too far for a visit to be practicable. But on 18 January I walked some 2½ miles west from Dilla, gradually descending through open bush to the edge of a wooded ravine. There a steep scramble down over rocks led to a river, running swiftly on its stony bed, at this season partly dry. Steep-sided ravines, or even small canyons enclosed by cliffs and 100 feet or so deep, are a feature of the dry thorn-scrub country in the floor of the Galla Depression.

The springs are situated on the north (right) bank of the river (an affluent of a system emptying into swamps at the north end of Lake Abaya, several miles east of the mouth of the Berberi-Billata). The hottest water, 135° F. (just over 57° C.) † was bubbling up from some small orifices in an otherwise dry part of the river-bed, near the steep bank. Hot water also trickled from the rocks above, issuing from crevices surrounded by blackish and green slime. One trickle was the spring of Maryam, another that of Ābō, an Ethiopian saint about whom strange legends are depicted in the frescoes in some churches (for instance, at Mt. Zuquāla). Placing the bulb of the thermometer in the water where it flowed from the rock, I recorded temperatures from 116° to 118° F. (about 47° C.) in two cracks of the Ābō spring. In a bathing-pool (112° F.) artificially constructed with rough rock-walling, men and women were immersed to the waist ; though quite unclad they showed, as is their wont, no sign of self-consciousness either of one another or at my approach. Negussie and Hailé (my *zabanya*) undressed and had warm baths, the former sitting on the rocks so that the Maryam spring water ran from a spout on to his head and shoulders. These springs emitted only a faint sulphurous smell.

Though the occurrence of certain aquatic beetles and other insects in thermal springs is well known, I found no insects in the hot water itself, except a Dipterous larva or two, with many processes on the body, which may have belonged to the Stratiomyiidae or a related family. But I took specimens of a Hydrophilid beetle from incrustations on the rocks down which the water from the Maryam spring trickles. Also many examples of a small water-beetle (*Bidessus*) were collected from a shallow pool in the river-bed ; this water felt cold to my hand, but the thermometer registered 88° F. (about 31° C.). As, however, the time was between midday and 1 p.m., the sun shining on the pool and the air temperature in the shade nearby 83° F., this water may have been heated solely by direct sun-heat, so I hardly consider the *Bidessus* to have been collected from hot-spring water.

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* That travellers bent on very different purposes and in lands far apart may be hindered by exactly the same cause is evident from the experience of Mr. Graham Greene, the author. In 1938, when investigating the plight of the Catholic Church in Mexico under anti-clerical persecution, he found transport on one occasion unobtainable because ' all the coffee had come down from the hills and the mules returned ' (*The Lawless Roads*, 1939, chap. viii).

† In June 1939 Professor Zavattari recorded 65° C. (149° F.) in the sulphurous springs on the islet of Thàbal, in the dry bed of Lake Stefanie (Zavattari 1942, p. 336, and plate opposite p. 333).

The tropical feeling and look of the ravine, as in all such places where there is water, was intensified by the large African butterflies, Acraeinae, Danainae and others, sailing to and fro.

These hot springs west of Dilla may be compared with that at Huweimi in the Aden Protectorate, near the southern frontier of the Yemen. There (9 December 1937) the spring bubbled from a deep hole in a grassy glade and my thermometer (the same instrument), lowered on a string into the source, registered 152° F. (67° C.). Water-beetles (*Guignotus signatellus*, Dytiscidae) were found in a channel below the spring, where the water-temperature was 120° F. (49° C.) ; while a pond, the temperature of which was 94° F. (35° C.) at the edge, was inhabited by another Dytiscid beetle (*Cybister vulneratus*) and two species of aquatic Hemiptera (*Mesovelia vittigera* and *Microvelia isis* ; see Scott, 1942, p. 79, and Reports 16 and 17, respectively by J. Balfour-Browne and E. S. Brown, of the *British Museum* (*Natural History*) *Expedition to South-West Arabia, 1937–8*, vol. i. 1951 ; especially the legend of pl. X, from which it will be seen that different species of Hemiptera were found in cold pools a few feet away).

Thus, the Arabian spring was hotter at its source by 17 degrees Fahrenheit than those near Dilla ; and aquatic Coleoptera were found in really hot water at Huweimi, but not in the springs near Dilla.

Phallic monoliths : the strange monuments, larger and far more numerous than those at Sōddu (p. 128), visited on a long day's excursion from Dilla, are discussed in Appendix A (pp. 168–72).

Return to Addis Ababa (26–28 *January*).

To conclude my narrative : with my men I travelled in a lorry partly loaded with hides and sacks of coffee, among which our packages were stowed. The 230 miles from Dilla to the capital were covered in three days, the drives occupying, respectively, about 10½, 13 and four hours ; the two former very jolting, dusty and hot. On the first day, besides a pleasant call at the Sudan Interior Mission Station at Wondo, I had a passing glimpse of Lake Awasa from its eastern shore. A small river flowing into the lake through dry bush of acacias and other trees, at an altitude of about 5,500 feet, had on its banks clumps of the papyrus-sedge or ' paper-reed ' (*Cyperus papyrus*), a plant noted at no other place throughout the journey.

Personal Acknowledgments.

The list of those whom it is a pleasure to thank after two complex Expeditions is long, though many names are perforce omitted.

Years have elapsed, but I unite with Professor Omer-Cooper in thanking those named by him (1930, pp. 196–7) for the help granted to us on our joint Expedition. H.I.M. the Emperor Hailé Sellassié graciously favoured both ventures ; in 1926, as the Regent Tafari Makonnen, he granted us after a personal interview permission to travel in his realm ; in 1948 he granted me, through the appropriate channels, the same favour. I would add the name of the late Blāta (Blātengetā) Heruy, who used to chaperon foreign visitors. This well-informed man did us many services, *inter alia* he accompanied me during the ceremonies when, as the only western European present, I attended the festival of the national saint, Takla Haymanot, at Debra Libanos, 1–4 January 1927 ; I met him again in England, where he eventually died in exile. Mr. C. F. Rey (now Sir Charles Rey, C.M.G.) introduced me to Ethiopia ; he encouraged my project before I left England, and I met him (with Lady Rey) again at Addis Ababa, January 1927*. Among British residents Colonel D. A. Sandford (then General Manager of the Abyssinian Produce

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* A meeting mentioned in his ' In the country of the Blue Nile ', 1927, p. 175.

Company, now Brigadier Sandford, C.B.E., D.S.O.) and Mrs. Sandford befriended me in many ways, putting their house at Mulu at my disposal and lending me horses.

At the Legation in 1926–7, the British Minister, Mr. C. H. Bentinck (now the Rev. Sir Charles Bentinck, K.C.M.G.) and Lady Bentinck showed me great kindness. We had been welcomed on arrival by the Chargé d'Affaires, the late G. T. Maclean, while the late Philip C. Zaphiro, C.M.G., Oriental Secretary, assisted us throughout. I recall too the hospitality of the late C. H. F. Plowman, C.M.G., and Mrs. Plowman at the Consulate at Harar, in January 1927.

I am indebted to the then Ambassador*, Mr. D. W. Lascelles, C.M.G., for generous hospitality after my arrival in 1948. With Colonel Curle, D.S.O., M.B.E., the Consul at Addis Ababa, and with Mrs. Curle, I have many common interests. In thanking other members (British and Indian) of the Embassy and Consulate staffs, I would particularly remember the learned Ethiopian Secretary and interpreter, Ato Emmanuel Gabré Sellassié.

I can scarcely express my indebtedness to Mr. Alfred Abel, Governor of the Agricultural Bank of Ethiopia. Through him I met the kindly Ato Ababa Gabré (then working in the Ministry of Interior, since highly promoted) and thus at length got access to the Imperial Private Secretary, Ato Tafara Worq. To the last-named I am specially indebted ; though we had corresponded before I left England, it was after my interview with him in Addis Ababa that difficulties were resolved and preparations for my southward journey were soon satisfactorily completed.

My hospitable old friend, the Rev. A. F. Matthew, for many years Anglican chaplain, has answered innumerable inquiries. With Dr. M. Giaquinto-Mira, then Director of the Institute of Medical Research, I discussed scientific matters, while he and his wife (an English lady) entertained me many times ; only serious illness prevented him seeking local leave to join me in the Gughé Highlands. Sincere thanks are also due to : Brigadier P. N. Banks, then Commissioner of Police under the Ethiopian Government ; Mr. David R. Buxton ; Mr. L. A. Tillin (then winding up an Anti-Locust unit) ; Messrs. G. E. Davis, D. Allin and other members of the commercial house of Antonin Besse (Ethiopia), also M. Justin Van Billoen, Agent of that house at Dilla, and his wife ; and Mr. Ward Smith of the Arabian Trading Company (for storing unwanted baggage *gratis*). By substantially reducing charges the local management of B.O.A.C. enabled me to reach Aden *with* my fragile collections in February 1949.

In the south I was very kindly treated by members of the Sudan Interior Mission (a remarkable organization drawn from the whole English-speaking world), notably the Rev. T. and Mrs. Simpson and their team at Sōddu, also the Rev. L. A. and Mrs. Davison and their staff at Shashamanna. The help given by Lij Ababa Gabré Ghiorghis, Acting Governor of Wolāmo ; by Dajazmach Garāsu Duké, Governor of Gamo-Gofa ; and by several Fitauraris administering districts, particularly Fitaurari Katta at Bonghé, is recorded in the narrative—also my debt to my men, especially to Negussic Effru, my caravan-leader on both journeys, now a good taxidermist and beetle collector, and to Ghidello Woldesayek, my polyglot personal servant.

Since my return I have been specially indebted to the following : Messrs. S. J. Turpin, J. Abraham and others in the Setting Room at the British Museum (Natural History) for particular care in mounting and labelling the insects, Mr. C. N. Hawkins, F.R.E.S., for voluntarily sorting the latter into families, and Mr. A. G. Gabriel, F.R.E.S., for promptly identifying the Rhopalocera ; Messrs. E. Milne-Redhead, M.A., F.L.S., and R. D. Meikle at the Kew Herbarium for quick determination of the plants ; and

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* The British Legation has been raised to the status of an Embassy.

Colonel F. C. Stern, O.B.E., M.C., F.L.S., V.M.H., for his efforts with the seeds. The specialists who have expeditiously studied groups of Coleoptera and Mollusca are mentioned in the text, also M. Marcel Cohen, who explained to me his views on the prehistoric monuments. Professor Kenneth Mason, M.C., M.A., gave material help (as well as advice) by allowing the maps to be drawn at the School of Geography, Oxford, where Miss Mary Potter devoted great care to their execution. Lieut.-Col. J. S. O. Jelly, R.E., and Major R. E. Wise, R.E., explained geographical points. Mr. Charles F. Beckingham, M.A., extracted the information from most of the recent articles on the monolithic columns cited in Appendix A. Mr. C. W. Plank, then Managing Director of Messrs. James A. Sinclair & Co., found no detail too trivial for supervision in the development and enlargement of the photographs; and Miss Betty Edwards of Henley-on-Thames has given far more than ordinary care to typing my manuscript. Lastly, I am deeply indebted to the Linnean Society for publishing this rather unorthodox work, and to Dr. A. Tindell Hopwood for his guidance.

APPENDIX A.

Archaeological and Ethnological Notes: the Phallic Monoliths, etc.

Though the subjects here discussed are outside the normal scope of the Linnean Society, keen interest has been shown in what I have been able to tell, in particular about the phallic monoliths, the existence and great number of which (they total several thousands) are little known to British readers.

I was not an entirely passive sight-seer of these monuments, such as lay near my route. When possible I took measurements, and noted the present state of the columns as compared with their condition when first described by Azaïs and Chambard twenty years ago. I have obtained a mineralogical report on the rock of which those of one group are composed. Moreover, by visiting a distinguished French expert, M. Marcel Cohen, since my return, I have heard something of the opinions held at present regarding their origin.

This Appendix is therefore grouped mainly under the following heads: phallic monoliths in Wolāmo and Sidāmo; wayside monuments and trophies of the Arussi and Kambāta peoples; the frequent use of cotton as a votive offering in Wolāmo; the addition of stones by travellers to wayside heaps commemorating persons or events, or associated with sacred sites; and, lastly, witchcraft. These notes are linked by cross-references to my narrative, from the main theme of which they would have formed too lengthy digressions. Some brief allusions to other ethnological matters (e.g. the 12-foot bamboo-trumpets in Wolāmo, p. 130, and the custom of soaking a wooden ball in the blood of an ox to harden it, p. 136) are left in the narrative, where they seem to fit best.

Phallic monoliths in Wolāmo and Sidāmo: carved stone obelisks, showing characteristic designs and a high degree of skill in the sculptors, are among the most striking antiquities of the ancient sacred city of Axum (Aksum) in northern Ethiopia. These, long known to the outside world, have been the subject of many writings; to mention only two books, Bent's fascinating account (1896) and Buxton's recent illustrations (1949, pl. 63). It is believed that this Axumite culture originated with Semitic colonists from South Arabia, and that the Axumite kingdom, Christianized about the 4th Century, A.D., was the centre from which the Christian realm of Ethiopia expanded. Be this accepted in its entirety or not, some recent writers have expressed doubt whether the several distinct types of megalithic monuments so numerous in the southern provinces owe their origin to Axumite influence. M. Marcel Cohen has stressed in his writings (also in conversation with me, April 1950) that the phallic monoliths may be due to an indigenous African cult; that African civilizations may have risen and fallen again, leaving little trace, and that origins need not necessarily be looked for in Arabia, the Nile Valley or Mediterranean lands.

Great numbers of these southern megalithic monuments were described and photographed by the explorers mentioned above (p. 109), Père Azaïs, formerly of the French Franciscan (Capucin) Mission at Harar, and M. Roger Chambard. They also enumerated some other monoliths of which they were reliably informed but which they could not reach. Their book (A. & C., 1931), of which it seems there are very few copies in Britain, is itself a monument to laborious explorations carried out during five years with meticulous care. Having travelled over some of the same country, I appreciate the arduousness of their task and the value of their data.

Before their systematic exploration, probably the first intimation of the existence of the phallic monoliths was due to the Vicomte Robert du Bourg de Bozas*, a brave but ill-fated traveller who died during his journey across Africa. In April 1902 he saw many stone columns near Abarra (Abera) in Sidāmo, some miles south of Agheré-Salam (Mission du Bourg de Bozas, 1906, pp. 246–7). But he does not seem to have recognized their phallic character. Like Père Azaïs and myself, he was told the legend of Ahmed Gragne's horse, related below. Presumably the monoliths seen by Du Bourg were among those later examined by Azaïs and Chambard.

The late Edmond Pottier in his Preface (A. & C., pp. vii, viii) classed the megalithic monuments as follows : (i) *funerary dolmens* in the Harar district, a discovery which ranges Ethiopia among the countries abounding in such monuments—an immense area, comprising parts of Europe, Asia and Africa ; (ii) *funerary tumuli* encircled with stones of a particular kind, in the Guraghé country (south-west of Addis Ababa) ; (iii) *menhirs* ; (iv) *sculptured stones*, either crudely representing the human figure, or horizontal rows of swords or daggers, in part of Wolāmo Province (Hodson gave rough sketches of stones of this type, 1927, pp. 24–5) ; and (v) lastly, greatest surprise of all when first brought to light, the *phallic monoliths*, not (as far as is known) marking burial places ; these amount to several thousands in the districts round Lakes Abaya and Chamo, found singly or in groups up to 50 or more.

It is not always easy to identify phallic monoliths seen more recently with one of the many groups illustrated by Azaïs and Chambard. I am not sure whether those shown in Mr. Buxton's recently published photographs (1949, p. 105, pls. 45–6) of a group at Michicha, 15 miles south-west of Dilla, were seen by Azaïs and Chambard ; they may have been, though the place is not indexed under that name. At any rate Colonel Curle has extended (1937) the known range of these monuments to British Somaliland.

Of the five categories enumerated above, I saw no dolmens or stones with sculptured swords, (i) and (iv). I am uncertain how to class the Arussi monuments described below, though some may fall under (ii). The upright basaltic stones at Konso (above p. 159) may probably be regarded as menhirs (iii). But I am principally concerned with what I saw of (v), the phallic monoliths. These amount to the following :—

(*a*) As mentioned on p. 128, two pairs on Menelik's Hill at Sōddu†, Wolāmo, respectively about six and four feet high (the larger are shown in Pl. 26 ; see A. & C., pls. 95 & 96).

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* Du Bourg de Bozas not only gave the first intimation of the existence of the phallic columns, but Dr. E. Brumpt (subsequently a Professor at Paris, highly distinguished in tropical medicine and medical entomology), who assumed the leadership after Du Bourg's death, brought back to France the first fossil fragments of giant mammals from the desert near the mouth of the Omo—a discovery whence eventuated the *Mission de l'Omo* of Arambourg and Jeannel (Jeannel, 1934, pp. 5–6).

† Azaïs and Chambard (p. 226) mention a group of phallic monoliths in Sidāmo at a place called Sodditcha. They considered this name to be derived from the same root as Sōddu town (Wolāmo) and Soddo district in Guraghé, 120 miles north—a root denoting these stones.

(*b*) A few miles south of Sōddu, east of the track to Humbo, two monoliths with the heads inclined together, not apparently very interesting in themselves, but mentioned below as bound round with cotton.

The above are all smaller than most of those seen later in Sidāmo, and differently shaped. The Sidāmo examples are :—

(*c*) A solitary monolith about six feet high, which I photographed about a mile west of Dilla, on the way to the hot spring (p. 165).

(*d*) Four groups within less than a mile of one another, north-east of Dilla, at or near Alāta. These total 50 or 60 large columns, but less than a dozen are still standing.

During a long but most interesting day's excursion from Dilla (22 January 1949), I worked for some hours with tape-measure, notebook and camera. I had wished to visit the strangely sculptured monoliths at Buqqisa (or Bucchise), west of Dilla (A. & C., pls. 76–7), but to find these would have meant camping out for a night, and 'no mules' was (as usual) the answer to inquiries. Negussie, however, managed to hire me a mule for the day, on which I rode under a hot sun for two hours up-hill, by the broad track leading to Agheré-Salam. My guide was the Van Billoens' gardener, a simple, hard-working man, incidentally a pagan, whose joy was to smoke a European briar-pipe given him by his employer.

The group of monoliths first reached was at a spot named (A. & C., p. 231, etc.) Watadera. The stone (Pl. 27) standing erect in a field, reaching just 10 feet above the ground and measuring nearly five feet in circumference at a height of five feet, is in every detail identical with that shown in pl. 74, fig. 2 (A. & C.). Near it lies a column broken into two pieces, together nearly 10 feet long, while a third fragment, if belonging to it, would make the total length 14 feet. Counting the roughly sculptured tops, some eight monoliths were lying in this field, several being partly buried, but two having lengths of 10 feet and more exposed. In the track outside the field, six fragments lie partly buried and two others in a small hollow nearby, but only two shaped ends are visible. This Watadera group must number ten or twelve monoliths at least.

Fragments of the fallen monolith with freshly broken surfaces, clearly shown in my Pl. 27, are incorporated in a heap of rough stones marking a modern grave. For it seems that several burials have taken place in this field since the visit of Père Azaïs. The Keeper of Minerals at the British Museum (Natural History), Dr. W. Campbell Smith, has kindly reported that a thin section of one of these small fragments proves the monolith to consist of a pale grey glassy porphyritic trachyte. Volcanic rocks of this type, related to other trachytes common in East Africa, may occur in many parts of Ethiopia.

Therefore, though I saw no exposed rock near by, yet the quarry may not, in the case of Watadera, have been far away. On the other hand, Azaïs and Chambard, excavating at the adjacent site of Alāta, found the monoliths to be all of hard granite, resting on calcareous rock lightly covered with marl; they found no trace of a quarry, so in this case the columns must have been carried some distance (A. & C., pp. 223 sqq.). Nothing appears to be known of the tools used in shaping the monoliths.

I went some half-mile farther, ascending and turning southwards, to three more groups, totalling between 40 and 50 columns. They looked like huge skittles, mostly toppling or fallen in all directions. I came on the groups, apparently those of Alāta (A. & C., pls. 69–72) as follows: first, two monoliths on a small mound; next, on a low broad elevation, whole monoliths or fragments representing about 30; then, a few yards farther south and up-hill, in a third group, almost all prone among coarse herbage, I counted ten shaped ends, while a peasant who had joined me claimed to have distinguished fifteen separate columns (one of the peasants watching me recalled the visit in his youth of two Europeans, evidently Azaïs and Chambard).

In these three groups together I counted only eight monoliths still standing, and all more or less leaning. Pl. 26 shows five of the eight. The lengths of the tallest, exposed above the soil, are 9½ to 10 feet. Another quite thick one had only five feet above the surface. Yet another, having about six feet exposed, is not cylindrical but flattened, nearly two feet wide but only about nine inches thick. The longest monolith, lying prone and partly buried, was 14½ feet long. Possibly the collapse of so many is a result of columns 14 feet long having been inserted in the ground only to a depth of about four feet.

The foregoing paragraphs include the sum of my personal investigations. My total of between 50 and 60 columns counted on that day (22. i. 1949) is a mere fraction of the 1,669 monoliths enumerated by Azaïs and Chambard at Watadera, Alata and neighbouring sites (A. & C., p. 233). As, having then no copy of their book, I had not read their description, and as many of the columns were hidden among bushes and coarse weeds, I did not recognize that the monoliths originally stood in irregular longitudinal bands extending from east to west, and I failed to see on their weathered surfaces the simple solar or astral designs on their eastern and western faces, and the cruciform designs facing south. Père Azaïs suggested that if the columns were associated with a solar or astral cult, the former designs may have been connected with the rising and setting sun, the cruciform designs with the Southern Cross.

Their excavations led Azaïs and Chambard to abandon the idea of a necropolis, as they found no trace of human burials, but bones of animals, possibly sacrifices ; also a polished stone axe, and fragments of pottery and of obsidian, the last having perhaps served as razors. Dajazmach Balcha had also excavated the soil close to another group of monoliths to a depth of three metres, but he found only stones engraved with cruciform signs and some bones, not human (A. & C., pp. 223–8).

It is difficult to say how far the original meaning of the monoliths is remembered. In Sidāmo at any rate the local people seemed quite ignorant about this. As told above, a fallen monolith at Watadera had recently been broken to furnish material for a grave, which presumably would not be done if the column were still venerated. My own men called the monoliths *pierres de Gragne*, alluding to a well-known legend ; even the sophisticated Ghidello accepted as historic fact that the 16th Century Somali conqueror, Ahmed Gragne, put up one of these pillars wherever he tethered his horse. Azaïs and Chambard, and Du Bourg de Bozas, were given the same explanation (A. & C., pp. 234, 246 ; Du Bourg, pp. 246–7).

On the other hand, in Wolāmo two monoliths south of Sōddu were bound with strands of cotton. I have mentioned below (p. 173) how common in that province is the practise of offering cotton, by attaching it to, or laying it before, sacred trees. The binding of the cotton round the monoliths would seem to show that they are venerated for some reason, though I cannot say whether their phallic character is recognized.

As intimated above, the origin of the phallic columns is undecided. So also is their date. Azaïs and Chambard, though leaving the interpretation of their discoveries largely to others, believed that they had found relics of an ancient Cushite culture which existed even before the earliest civilization of Axum, or that of Meroë and Napata in the Nile valley. While ascribing this ancient Cushite culture to a period lasting from the 2nd or 1st Century B.C. till about the 7th Century A.D., they agreed with the opinion that it extended much farther south than the Semitic culture of Axum and was not influenced by the latter*.

A contrary view was expressed by C. Conti Rossini, who attributed all the megalithic monuments to Axumite influence (*Oriente Moderno*, 1926, pp. 342–6). But M. Marcel Cohen (1927–33), reasoning (as stated above) that cultures wholly unconnected with Axum may well have risen and fallen in southern Ethiopia, points to the segregation of the different types of monuments in separate districts as indicating distinct origins; also to the possibility of Sudanese and Somali influences (as regards the latter, compare Col. Curle's discoveries (1937)). Lastly M. Cohen stresses the present-day phallic cults of the Galla and the Kafficho (the people of Kaffa). Cerulli also comments (1932–3, vol. i, pp. 42, 48–9) on the wide diffusion of phallic ideas in eastern Africa, the use of phallic emblems by some Galla tribes in ritual dances and their worship of Ateté, goddess of fertility. The prominence of such emblems in the wooden funerary statues of the Konso today has also been mentioned (p. 160). The continuance of the cult in contemporary times increases the difficulty of dating the monoliths.

Other writings, the contents of which I cannot detail here, are those of Littmann (*Orientalistische Literaturzeitung*, 1933, no. 11, coll. 695–8) and Mlaker (*Archiv für Orientforschung*, 1933–4, pp. 345–7).

Since the opinions summarized above are largely speculative, it may be hoped that scientific methods of dating, now coming into more general use, will be applied to these monolithic columns in southern Ethiopia (see, for instance, Professor Zeuner, 1951).

Wayside monuments and trophies of the Arussi and Kambāta peoples: Arussi monuments to defunct warriors are numerous in the sparsely wooded country a little farther south; near Shashamanna. But they are not always burial-places. Those shown in Pl. 28 are one of two pairs of stones about three feet high, on either side of a heap of rough stones, probably a grave; the two pairs of upright stones face, respectively, south of east and north of west. The single stone shown in Pl. 27, facing nearly east and west, may mark a grave or not. But the trophies raised on poles (in this case with bark removed in alternate sections), consisting of skins stretched on sticks and an inverted earthenware vessel, are of a type sometimes erected away from any grave.

It is said that such trophies commemorate the deceased man's prowess in war or as a hunter. Colonel Curle, however, thinks that skins and earthenware vessels may be emblems of the food and drink needed by the spirit in the unseen world. He has also warned me that some of these memorial stones may have been moved, for instance, during road-making under the Italian régime; in one case he saw many such stones placed in a regular row, like headstones on modern graves. Moreover, though some of the stones look quite recent, others appeared to Colonel Curle to have been renovated, and the colouring in the grooved designs renewed. He noted an ochreous colour used for this purpose. I noted black designs on a whitened surface in the single stone (Pl. 27 and fig. 7), the other side of which bears different designs and was not whitened.

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* The main phases of Ethiopian history recognized by Azaïs and Chambard themselves (A. & C., pp. xiii, xiv) were: (1) Ancient Cushite cultures, Agau in the north and Sidāma in the south, the latter influenced by adjacent negro peoples; (2) Semitic culture, imported by colonists from South Arabia, resulting in the formation of the Axumite realm in the 4th Century A.D. and (eventually) the Amhara Ethiopian empire late in the 13th Century; (3) maximum southward extension of the Ethiopian empire in the 15th Century, followed by withdrawal northwards in the 16th, under the blows of Muslim armies from the south-east (Harar, etc.) and of Galla invasions from the south; (4) re-occupation and extension of the southern provinces by Menelik and his armies (Shoans, etc.) at the end of the 19th Century. They referred the phallic monoliths to heading (1), dating from even earlier than the civilization of the last two centuries B.C. and the early centuries A.D. reviewed by A. Kammerer (*Essai sur l'histoire antique de l'Abyssinie; le royaume d'Aksum et ses voisins d'Arabie et de Meroé*, 1926), whose witness to the importance of their discoveries they quote.

I have learnt through the Rev. W. A. Ohman (Sudan Interior Mission) that the colouring-matter (ochreous and black) is derived from berries of local plants.

A remarkable monument (Pl. 5), west of Shashamanna is said to be that of an Arussi chief who was also a Muslim, an unusual combination. The rather kiln-like, circular, three-tiered stone erection is surrounded by wide upright stones bearing strange devices (possibly primitive representations of the human figure).

The late Sir Arnold Hodson (1927, opp. p. 264) photographed over 20 poles in a row commemorating a dead warrior, near the saline lake, Hora Abjata (or Hora Daka) in southern Arussi country; while Capt. A. Dunlop (1937, p. 511) shows trophies on poles in other Galla country, far removed from Arussi. Such memorials seem to be segregated in Galla districts far apart.

A wayside tomb of a *Kambāta* chief, seen shortly after crossing the Berberi–Billata River, on the way to Shoné, is illustrated in Pl. 28. This differs somewhat from the Arussi tombs described above. Various forms of rough stone cairns are found in this part of Africa, and both of these tombs should be compared with those in the Danakil desert (Thesiger, 1935, pp. 9–12; Buxton, 1949, p. 161, pls. 109–10).

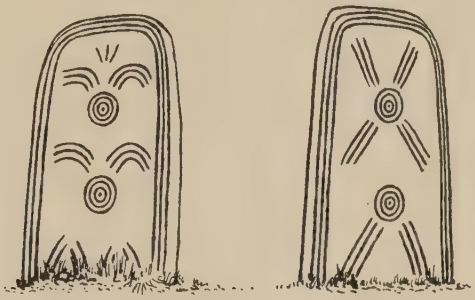

FIG. 7.—The Arussi memorial stone seen in Pl. 27, showing different designs on the west (left) and east sides (drawn from the author's photographs).

Possible relationship with tribal marks of the Masai: my photographs of these Arussi memorial stones having recalled to Dr. Hopwood the tribal marks which he had seen among the Masai some 20 years ago, he kindly drew my attention to Merker's book on that people. Without pretending to any knowledge of this subject, I am struck by the general resemblance of the designs on the Arussi stones to the blazonry on the Masai shields shown in photographs illustrating Merker's book and in his two Plates of diagrams, the first entitled simply 'Schildwappen', the second 'Geschlechtszeichen auf Schildern' (Merker, 1910, figs. 28–30 and 37, pp. 78–82 and 95, also pls. 1, 2). Such shields are also well shown in two photographs reproduced in 'African Morning' by Mr. R. O. Hennings (1951, facing pp. 17 and 224).

Tombs of the Wolāmo: Wolāmo graves are surmounted with wooden structures so much like a small flimsy edition of the houses of the living that I have left the description of them in the narrative, following my remarks on the Wolāmo type of house (p. 130).

Use of cotton as votive offerings: this practice persists among wholly or partly pagan people in Wolāmo and Gamo Provinces. A little south of Sōddu I passed two phallic monoliths, almost touching one another, both bound round with strands of spun cotton. Some way north of Borroda, again, the track lay between two large wild fig trees, the trunks of which were bound with white cotton strands, several feet above the ground. Cotton strands were stretched from branch to branch of a solitary euphorbia beside the mountain road south of Borodda. Each passer-by knelt and added a stone to a large heap at the base of this *quolquol*-tree (Pl. 17), bowing at the same time towards a distant church, hidden in trees on the far side of the valley, doubtless on some pre-Christian sacred site (further instances of this custom of adding stones to a heap are given below). Yet another great sacred tree, bound round the trunk with strands of cotton-twine, stood in a small enclosure of plaited bamboo screens beside the track from Chencha to Ochollo market. Between Algudi and Zaga, also, strands of cotton, in one case arranged in a ring, lay on the hay with which the lower limbs of a huge sacred wild *Ficus* were covered. At several other points, nearly as far south as Ghidolé, offerings of cotton lay before sacred trees. Hodson (1927, chap. ii, p. 28), who noticed this custom specially in Wolāmo, associated it with the desire for some piece of good fortune, such as the birth of a son.

Apparently in Wolāmo and Gamo these votive offerings of cotton take the place of anointing of sacred trees and stones with butter and the offering of trinkets, as practised in the Galla districts (Omer-Cooper, 1927 *b*).

Besides cotton, I saw collections of rags hung on trees in Gamo. Vannutelli and Citerni (1899, p. 267) record a fine sacred tree hung with monkeys' skins, also in Gamo.

Addition of stones to wayside heaps by travellers: apart from the special meaning associated with this act in the case mentioned just above (the heap of stones at the base of a *quolquol*-tree, and the bowing towards a church), the custom of adding a stone to a wayside heap by each passer-by is in itself very widespread. In Britain stones are sometimes added to cairns on mountain-tops by climbers, probably from simple pleasure at having reached the top. Elsewhere the custom has other causes. The Old Testament books record instances of heaps of stones being raised for several reasons. The custom still prevails in eastern lands. In Arabia, pilgrims to Mecca add stones to a great heap on the way back to Jidda, as testimony of having fulfilled the pilgrimage (Doughty, chap. xviii); and in the Hadhramaut tribesmen are accustomed to build a *mesh-hed* or ' place of witness ' to mark the spot where a comrade was killed, or as a thank-offering for deliverance from danger. Each passing tribesman adds a stone to the heap, even long after the incident is forgotten. Near Mukalla beduins will add a stone to a heap called *Qabr Ferenji* (the foreigner's grave), alleged by some to be the grave of a Portuguese who came to supervise the building of an aqueduct (Ingrams, 1949).

Yet nearer to Ethiopia lies British Somaliland, to the *arawailos* of which Col. Curle has called my attention. Tradition asserts that Arawailo, a great tribal queen in remote times, so antagonized her male subjects that at length they killed her. The women, by whom she was beloved, buried her with great ceremony. But men came from far and near to hurl stones at her grave in contempt. They do so to this day (in more places than one), while the women put rags, torn from their dresses, among the stones in token of respect to Arawailo (the full story is given by Drake-Brockman, pp. 168 sqq.).

As remarked by Du Bourg de Bozas (chap. iv, pp. 57–8), the heaping of stones over actual graves is a deterrent to jackals, hyenas and other beasts seeking to disinter bodies.

Witchcraft: as recorded above (p. 129), in Wolāmo the owners of fields of *godari* (*Colocasia antiquorum*) frequently erect poles stripped of their bark in alternate bands, and surmounted by inverted earthenware vessels, skulls of oxen, rags and other things. Later in my journey I saw in the Gughé mountains curious erections of bamboo in certain fields of young barley. These appeared fewer than the poles in Wolāmo, where the tuberous-rooted *godari* seemed specially but not exclusively afforded this protection. My men were disinclined to explain the purpose of these objects clearly, beyond saying that they in some way warn trespassers off, or protect the crops against those who would damage or steal. I wondered if these erections might be intended to ‘ avert the evil eye ’ or for some other occult purpose. Recently, however, Miss Christina Hole (author of ‘ Witchcraft in England ’, 1945, and other works on folklore) has suggested to me that the poles may be intended to warn off evil spirits rather than living trespassers ; and that possibly the wayside monument-poles of the Galla, resembling the smaller poles in the fields of Wolāmo though on a bigger scale, may be meant to protect the dead buried close by, or to prevent the spirits of the latter from wandering and harming the living. Miss Hole also noted a distant resemblance between these poles and the ‘ may-poles ’ of the Welsh border, really sapling birch-trees adorned with red streamers, formerly set up against stables and cow-sheds from one May-day to the next to protect the animals against witchcraft. But whether there is a true relationship between these customs in Britain and in Ethiopia is an open question.

A witch-doctor : in the Bonghé valley dwelt a man of local repute whom Ghidello termed *un sorcier*, more correctly (I think) a witch-doctor*. His house stood alone (the giant cabbages and *enseté*-trees shown in Pl. 16 were in his garden). In front, on a stretch of open grass-land crossed by a public track, a circle about four feet in diameter had been cut in the turf. At its centre were planted two tall (dead) stems of bamboo, perhaps 20 feet high, and a young living shoot of euphorbia about two feet high. Two other pairs of bamboo were stuck in the ground at the back and side of the house, one pair rising among the foliage of a young *kosso*-tree (*Hagenia*), the other pair amid the branches of a young *tid*-tree (*Juniperus* ; the doctor had probably brought this tree from a distance, as I saw no others in the district). I got only one glimpse of the doctor, whose outward appearance differed in no way from that of his neighbours, except that his hair was dressed in long wisps. He had another house some way off and he seemed to be often summoned away to visit sick people and animals. I questioned Ghidello about the meaning of the circle cut in the turf, but he was reticent, only vouchsafing that *peut-être on y fait quelque-chose.*

APPENDIX B.

THE NAMES ETHIOPIA AND ABYSSINIA.

Confusion is liable to arise over these terms from two standpoints, zoogeographical and historical.

The use of *Ethiopian* to denote a zoogeographical Region including all tropical and South Africa (and, in its original sense, also Madagascar and the tropical part of Arabia) is confusing when this adjective is also applied, possibly in the same work, to the Empire of Ethiopia. I cannot enter into this question, beyond remarking that the term *Palaeotropical* has been suggested in place of *Ethiopian* for the zoogeographical Region (Zavattari, 1943).

I am more concerned about the use of the two names for the modern political state, a matter in which I have compromised by keeping ‘ Abyssinia ’ as a geographical term, while respecting the wish of the Ethiopian authorities that their country shall be called ‘ Ethiopia ’. Therein lies a controversial historical point, affecting the results of my two expeditions.

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* He was probably a witch-doctor or ‘ medicine man ’ rather than a ‘ sorcerer ’. I found this distinction drawn in a little book entitled ‘ From Cannibalism to Christ ’ (1944) by the Rev. John S. Hall, for many years a learned missionary to the Tangale tribes of Nigeria. In his chapter 11 (p. 86) Mr. Hall classes *sorcerers* as wielders of destructive magic ; while he terms magic-doctors or medicine-men *group diviners*, stating that they are spiritistic mediums. This distinction applied to tribes in West Africa may not be fully applicable in Ethiopia ; yet the motives of the ‘ doctor ’ at Bonghé and his like are probably benevolent. I am not competent to enter further into this far-reaching subject.

Omer-Cooper and I used " Abyssinia ' in the title of our joint Expedition and throughout the published results ; that name also stands on tens of thousands of printed labels attached to the specimens we collected. For the country has been generally (though not always) called Abyssinia in works of travel and exploration. Moreover, numerous species have been named *abyssinicus*, *abessinus*, etc., before and since our Expedition, and consequently stand thus in catalogues and indexes. Therefore, though some highland species have also been named *aethiopicus*, the retention of the name Abyssinia in a geographical sense is necessary.

On the other hand the state is officially ' Ethiopia ', and for centuries in the older Empire the title of the Negus was ' King of Kings of Ethiopia '. Though in 1926–7 ordinary folk did not object to being called Abyssinians, and though the adjective *habasha* (Abyssinian) is still commonly used, the authorities insist on ' Ethiopian '. If *Habashat* really originated as a foreign designation from outside the country, and still more if it implied a mixed racial character in the people, resentment among those endeavouring to unify the Empire is understandable. At all events I have adopted ' Ethiopia ' in the official title of the 1948–9 Expedition, and had it printed on the covering labels (not on the detailed locality-labels) attached to the insects collected.

From a historical standpoint the subject is matter for argument. To European readers the term Ethiopia is ambiguous. In ancient times it meant vaguely the countries south of Egypt, more particularly large lowland regions now forming part of the Sudan (i.e. Nubia, etc., and notably the ' island ' of Meroë) ; while in early Christian times, at any rate from the 4th Century, the northern part of the highlands was the kingdom of Axum. Even in some comparatively modern books ' Ethiopia ' is restricted to Nubia, while the highlands are termed ' Abyssinia '. Yet the application of both names to the highland Empire by various European writers is of long standing. Some authors indeed use the two terms synonymously for the highland realm (e.g. Bent, 1896, and Gibbon, The Decline and Fall of the Roman Empire, chaps. xlii and xlvii). A recent suggestion to restrict ' Ethiopia ' to the highland Empire and to revive the Biblical name ' *Cush* ' for the ancient Ethiopia would surely only increase the confusion. In short, if we *must* call the Abyssinian highlands Ethiopia, we may at least think of them as ' high Ethiopia ', remembering that the ancient Ethiopia was a lower country to the north (compare also Wylde, 1901, p. 16 ; Rey, 1923, p. 27, and 1927, p. 31 ; Buxton, 1949, p. 17).

Moreover, since I wrote the above lines, this old meaning of the term ' Ethiopia ' has entered into present-day affairs. For, in the discussions about the future of the Sudan, the leader of one Sudanese political group, in arguing for complete independence, is pointing out that the Sudanese are descended from the people of Tirhaka (Taharqa), King of Ethiopia in the 7th Century B.C., the last of the Ethiopian kings who conquered Egypt and ruled as the 25th Dynasty ; and that the Sudanese are also descended from the people of Candace (a title borne by many queens of ancient Meroë), whose minister was baptized by Saint Philip, as recorded in the eighth chapter of the Acts of the Apostles.

APPENDIX C.

Transliteration of names ; Meaning of Titles.

There is no universal standard system of transliterating Ethiopian personal and place-names. These may belong to many different languages and dialects, especially in the southern districts here described. But neither in Amharic, which possesses written characters and is now the official language of the whole country, nor in the very widely spoken Galla (or Oromo) tongue, is there any uniform method, so Ethiopian names are spelt differently in each principal European language.

The Italian spelling used in the recent editions of the International Map is not adopted here, because it may mislead English-speaking readers unfamiliar with the country; e.g. when the well-known railway-station written *Mojjo* or (*Modjo*) is italianized as *Moggio*, some people pronounce it as rhyming with *foggy-oh*.

Some of the more important names for which I have adopted English spelling are listed in the following table of transliterations :—

English	*Italian*	*French*
Agheré Salam	Agheressalam	Aguéré Salam
Chamo	Ciamo	Chamo
Chencha	Cencia	Tchintcha
Chillālo	Cilalo	Chillalo
Hawash	Auasc	Awache (or Aouache)
Jabasirri	Giabassirè	——
Jem-Jem	Giam-Giam	Djem-Djem
Muger	Mugher	Mouguère
Shashamanna	Sciasciamanna	——
Shoa	Scioa	Choa
Wolāmo	Uolamo	Wallamo
Yavello	Iavello	——

I have adopted *gh* to denote a hard *g* before *e* and *i*, as in *Alghé*, *Bonghé*, *Gughé*, *Ghidolé*, *Guraghé* (and the personal names *Ghiorghis**, *Ghidello*); but the *gh* is simply a hard *g*, it has no *ghr* sound, as the Arabic *gh* (*ghain*) has. (ERRATUM: that *Bulgita* is spelt thus on the Route-Map, and not *Bulghita* as it should be, is my own mistake.)

Though not speaking the languages, I often detected differences of pronunciation of vowels, even among educated Ethiopians. For example, *Chencha* is also sounded *Chincha*; *Shashamanna* (though written thus in Latin characters on the door of its post office) is also called *Shashamanné*, and a similar variability in terminal vowels was noticeable in some of the village names on my maps. Among the peasants pronunciation doubtless varies still more, as when a local guide at Sōddu called Lake Abaya *Abācha*.

For the capital I keep consistently to the original Amharic *Addis Ababā* (=new flower), though I have heard the incorrect form favoured by many Europeans, *Addis Abéba*, also used by some Ethiopians.

Lastly, many places have several quite different names in the languages of the distinct peoples living near by (see remarks on the names of the lakes, p. 110). Or Amharic names may for official use displace local names; thus, *Dallé*, *Hula* and *Alghé* on the International Map are now more usually called *Irgalam*, *Agheré Salam* and *Agheré Maryam* respectively. On my route-map I have given both names to each of these places.

Titles, etc.: of the personal designations used in the text, *Ato* corresponds to 'Mr.' *Lij*, the ordinary word for 'child', is in some cases applied to the son of a prominent man long after the young man is grown up. *Blātengetā* (abbreviated to *Blāta*), an honorific derived from two words, means literally 'boy master'. A *shūm* (French transliteration, *choum*) usually means a local head-man, set over a village if a compact village exists, or over a small district. Larger districts are administered by *Fitauraris* under their respective Governors of provinces; the only Governor whom I met held the rank of *Dajazmach*. These titles had (formerly at any rate) a military significance. When Menelik's armies went to war a half-century past, the advanced guard was commanded by a *Fitaurari*; a *Dajazmach* (also shortened to *Dajach*), i.e. a general, was in the centre, or a *Ras*, if present. In large forces the right and left wings were commanded respectively by a *Qagnazmach* ('Kanyazmach') and a *Garazmach*, but I have had no occasion to use these words (see Wellby's diagrams of military formations, 1901, pp. 81–3). *Ras* is a higher rank than any of these; some Provincial Governors still have this title, but no Rases are now almost independent hereditary rulers of provinces, as some formerly were. The only ones whom I met were Rases of the old régime, living in retirement. Numerous other titles exist, civil, military and ecclesiastical.

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* I here spell the Amharic form of George thus, as both its *gs* are hard, but it is commonly transliterated *Giorgis* in English writings.

A *katamā* (or *catamā*), now meaning an ordinary town, originally meant a permanent as opposed to a movable encampment, and probably a stockaded place, as some katamās still are. A *ghibbi* (or *gibbi*, enclosure) is the name usually applied to a chief's house and is also still applied to the old Imperial Palace in Addis Ababa. In the country districts, at any rate, residences of chiefs have a courtyard enclosing several separate buildings and surrounded by a stockade.

BIBLIOGRAPHY.

This consists of two parts: (1) a list of the published results of the 1926–7 Expedition, and (2) references to works cited in the present Report (see 'References', p. 181).

(1) *Results of the 1926–7 Expedition.*

The subjoined list is intended primarily to show which parts of the collections have been worked out. Most of the taxonomic papers are not cited in this Report, but a few papers, to which specific reference is made in the text, are fully cited below under 'References'; these items, therefore, are included in the subjoined list only under the author's name and date, as it is unnecessary to give the full reference twice over.

Systematic entomologists will notice gaps. Nevertheless, though much of the material collected has still not been studied, or only incompletely, this list will justify the claim made on p. 87 that 'the joint Expedition of 1926–7 greatly increased our knowledge of the fauna'.

General articles: see 'References' under OMER-COOPER, 1927, 1929, 1930 and SCOTT, 1927 *a*, 1950.

Mr. Omer-Cooper's Investigation of the Abyssinian Fresh Waters: besides his 'Preliminary Investigation' published in 1930, Professor Omer-Cooper has been responsible for the following series, mostly under the general title at the head of this paragraph, and all in *Proc. Zool. Soc.*: 1930, Part 1, 1–6, Amphibia, by H. W. PARKER; *t.c.* 63–4, Hydras, by S. J. HICKSON; *t.c.* 161–79, pls. i–iv, Copepoda, by A. G. LOWNDES; Part 2, 415–27, Coleoptera, Gyrinidae, by J. OMER-COOPER; *t.c.* 437–66, Hemiptera*, Notonectidae, Pleidae, Corixidae, by G. E. HUTCHINSON (Supplementary Report by same author, 1932, Part 1, 125–30); Part 4, 914–27, Hydracarina, by C. WALTER; 1931, Part 1, 31–2, Coleoptera, Haliplidae, by E. J. PEARCE; Part 2, 429–43, Freshwater Nematoda, by I. FILIPJEV; Part 3, 751–801, pls. i–ix, Coleoptera, Dytiscidae, by (Mrs.) Joyce OMER-COOPER; *t.c.*, 865–78, pl. i, Rotifera, by D. L. BRYCE; 1932, Part 1, 81–6, Hirudinea, by W. A. HARDING; Part 2, 227–56, Oligochaeta, by J. STEPHENSON; Part 3, 677–708, pls. i–vi, Ostracoda, by A. G. LOWNDES; 1947, **117,** Part 4, 716–41, Coleoptera, Palpicornia, by A. d'ORCHYMONT.

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* No *Gerridae* were included, but a paper by TEISO ESAKI on 'The water-striders of the subfamily *Halobatinae* in the Hungarian National Museum' (*Ann. Mus. Nat. Hungar.*, **23,** 117–64, 1926), contains the description of *Metrocoris nitidulus* and mention of an undetermined genus and species (*op. cit.* 126, 164). These were discovered by E. KOVACS, respectively on Lake Abasse (? Abaya) and Lake Debbel or Zwai.

To this series may be added: Land and freshwater MOLLUSCA, see References, CONNOLLY, 1928; and WOODLICE (ISOPODA TERRESTRIA), by K. H. BARNARD, 1940, *Ann. Mag. Nat. Hist.* (11), **6,** 355–66.

Excepting one short paper on a Vertebrate animal, the following all deal with land insects (though including a few groups aquatic in their early stages). Though I could not arrange the appearance of all these in one publication, I have as far as possible linked them together under the general title ENTOMOLOGICAL EXPEDITION TO ABYSSINIA, 1926–7, and in many I have inserted an introductory note. Reports on certain groups and some isolated descriptions of species have, however, appeared *hors série.* It seems best to adopt a taxonomic rather than a chronological arrangement:—

VERTEBRATA, O. THOMAS, 1927. A new bat of the genus *Myotis* from Abyssinia, *Ann. Mag. Nat. Hist.* (9), **19,** 554–5.

INSECTA: COLLEMBOLA, E. HANDSCHIN, 1929, *Trans. Ent. Soc. Lond.*, 15–28.

ORTHOPTERA (MANTIDAE, GRYLLIDAE, TETTIGONIIDAE, ACRIDIDAE), see UVAROV, 1934 in References. No account of the BLATTIDAE (or of DERMAPTERA) appeared, but for a remarkable Blattid discovered later, see above (p. 102) and CHOPARD, 1950.

ISOPTERA: I have not found termites plentiful above 8,000 feet, but the late Professor F. SILVESTRI described a new species, *Neotermes superans*, from Jem-Jem Forest, 1927, *Boll. Lab. Zool. Portici*, **21,** 91–3. He also named the following three species: *Termes anceps* Sjöst. (from a ravine in Mt. Wachacha, near Addis Ababa, and from Mulu, above the Muger Valley, both *c.* 8,000 feet), *Termes monodon* Gerst. (from a ravine between the Hawash River and Lake Zwai, *c.* 6,000 feet), and *Termes bellicosus* Smeathman (from the shores of Hora Harsadi, Lakes of Addas, *c.* 7,000 feet); these records have not hitherto been published.

EMBIOPTERA: see below, with Neuroptera.

EPHEMEROPTERA: see below, with Trichoptera.

ODONATA and PLECOPTERA: to my regret no Report on the dragonflies and stone-flies has appeared. I have MS. lists of determinations of the dragonflies by my friend, the late Kenneth J. MORTON, dated April–May 1927, and a number of his letters written about the same time, but publication was deferred owing to the impossibility of determining precisely certain species of *Ischnura* and *Agriocnemis*, of which no male specimens had been obtained. The collection comprised representatives of 14 genera and at least 18 species. Morton considered none as new to science, though in several cases he had seen no examples from Ethiopia. He regarded the absence of certain groups, the subfamily Gomphinae and the family Calopterygidae (the former he knew to be represented in Ethiopia, while both groups are attached to running waters) as due to seasonal causes, i.e. the material was collected at the end of the Rains and during the following dry weather. He thought the same cause applicable to the apparent scarcity of Plecoptera, of which I got only a few specimens of the genus *Neoperla*, still undetermined.

THYSANOPTERA: Dudley MOULTON, 1928, *Ann. Mag. Nat. Hist.* (10), **2,** 227–48.

HEMIPTERA: much material, but no Reports have appeared except those on the water-bugs listed above in Professor Omer-Cooper's series.

TRICHOPTERA and EPHEMEROPTERA: G. ULMER, 1930, *Ann. Mag. Nat. Hist.* (10), **6,** 479–511.

NEUROPTERA and EMBIIDINA: P. ESBEN-PETERSEN, 1928, *op. cit.* (10), **1,** 442–50, pl. xvi.

LEPIDOPTERA: MICROLEPIDOPTERA (including representatives of 15 families), E. MEYRICK, 1932, *Trans. Ent. Soc. Lond.*, **80,** 107–120;

GEOMETRIDAE, H. R. DEBAUCHE, 1937, *Ann. Mag. Nat. Hist.* (10) **20,** 320–44, pls. vii, viii; RHOPALOCERA, see CARPENTER, 1935, cited in References, and subsequent comments by same author, *Proc. R. Ent. Soc.* (B), **5,** part 10, 196–200, 1936 (our rather small but interesting collection of butterflies was amalgamated for purposes of study with Sir Arnold Hodson's large collection, Professor Hale Carpenter basing his fine 'faunistic study' on the whole: I wrote an essay-review on this work, *Science Progress*, **31,** no. 121, 155–7, 1936)*.

COLEOPTERA: four Reports on the families of water-beetles are listed above in Professor Omer-Cooper's series. The following have appeared on land-beetles:—CARABIDAE, ALLUAUD, 1937 (with CICINDELIDAE, by H. SCOTT); CARABIDAE, TRECHINAE, JEANNEL, 1936 (also 1950); CARABIDAE, genera *Bembidion* and *Tachys*, F. NETOLITZKY, 1937, *Ann. Mag. Nat. Hist.* (10), **19,** 410–21; CARABIDAE, AGONINI, L. BURGEON, *t.c.* 539–44; STAPHYLINIDAE, M. BERNHAUER (Introduction by H. SCOTT), 1931, *Journ. Linn. Soc.* (*Zool.*), **37,** 559–605 †; PSELAPHIDAE, R. JEANNEL, 1951, *Ann. Mag. Nat. Hist.* (12), **4,** 225–49 (includes material of 1948–9 Expedition); SCYDMAENIDAE, J. LHOSTE, 1936, *op. cit.* (10), **18,** 610–19; HISTERIDAE, G. MÜLLER and H. SCOTT, *op. cit.* (11), **13,** 519–46, no. for August 1946, publ. August 1947; CORYLOPHIDAE, R. PAULIAN, 1940, *op. cit.* (11), **6,** 26–35; COCCINELLIDAE, R. KORSCHEFSKY, 1935, *op. cit.* (10), **16,** 53–65; CRYPTOPHAGIDAE, see SCOTT, 1935 (this paper includes descriptions of *Mnionomus rhynchopetali* and *Atomaria chillaloensis* from Mt. Chillālo); COLYDIIDAE, H. E. HINTON, 1941, *Ann. Mag. Nat. Hist.* (11), **7,** 145–172 (*Euxestoxenus ovalis*, described by G. J. ARROW, 1937, *op. cit.* (10), **20,** 105, was placed by him in Colydiidae); ENDOMYCHIDAE, *Danae jucunda* was described by G. J. ARROW with other new African species, 1936, *op. cit.* (10), **18,** 374; ELATERIDAE, E. FLEUTIAUX, 1935, *op. cit.* (10), **16,** 48–53; BOSTRYCHIDAE, P. LESNE, 1938, *op. cit.* (11), **2,** 387–95; BUPRESTIDAE, A. THÉRY, 1937, *op. cit.* (10), **20,** 208–32; PSEPHENIDAE, DRYOPIDAE, ELMIDAE, H. E. HINTON, 1940, *op. cit.* (11), **6,** 297–307; (LYCIDAE, see below, with Brenthidae); ANTHICIDAE, M. PIC, 1951, *op. cit.* (12), **4,** 125–36 (includes material of 1948–9 Expedition); CURCULIONIDAE, see HUSTACHE, 1936; CURCULIONIDAE, APIONINAE J. BALFOUR-BROWNE, 1942, *op. cit.* (11), **9,** 793–824; SCOLYTIDAE, H. EGGERS, 1936, *op. cit.* (10), **18,** 28–33 (includes PLATYPODIDAE); BRENTHIDAE and LYCIDAE, R. KLEINE, 1937, *op. cit.* (10), **19,** 578–83; SCARABAEIDAE, H. SCOTT, 1940, *op. cit.* (11), **6,** 1–26 (based mainly on determinations by G. J. Arrow, R. Paulian and F. Ohaus).

HYMENOPTERA: (1) APOIDEA (exclusive of *Andrena* and *Halictus*), J. D. ALFKEN, 1932, *Trans. Ent. Soc. Lond.*, **80,** 47–55; (ii) SPHEGIDAE and PSAMMOCHARIDAE, G. ARNOLD, 1933, *Ann. Mag. Nat. Hist.* (10), **11,** 351–71 (includes supplementary list by H. SCOTT); (iii) TENTHREDINIDAE, FORMICIDAE, MUTILLIDAE, SCOLIIDAE, MASARIDAE, VESPIDAE, R. B. BENSON, J. BEQUAERT, A. v. SCHULTHESS and H. SCOTT, 1933, *op. cit.* (10), **12,** 97–120 (I compiled the accounts of the ants, Mutillidae and Scoliidae, based on determinations by several specialists, and added a supplementary list of Vespidae drawn up from the British Museum collection).

These Reports numbered i to iii covered the sawflies, ants, solitary and social wasps (*sens. lat.*) and part of the bees. I hoped that a fourth Report, headed 'Hymenoptera iv' would have appeared, by P. Blüthgen, dealing with the remainder of the bees, i.e. the family Andrenidae, notably the genus *Halictus*, among which he distinguished a number of new and presumably endemic species. I received more than half the manuscript of his Report, but he could not complete it before the Second World War, since when communication with him has been impracticable. (The material of ichneumon-flies and other parasitic families was small, and the publication of a faunistic Report was not contemplated.)

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* An important addition to knowledge of the butterflies is contained in Mr. A. G. Gabriel's 'Notes on the Rhopalocera of Abyssinia' (*Proc. R. Ent. Soc.* (B), **18,** 207–16 pl. 1, 1949), based on material collected by Mr. K. M. Guichard, largely at lesser altitudes than the material studied by Prof. Hale Carpenter, though Mr. Guichard's altitude-figures are unfortunately not given.

† *Stilicus scotti*, a species remarkable among its congeners, though based on a single specimen collected in Jem-Jem Forest in 1926, was not described or figured till 1951 (G. FAGEL, *Bull. Inst. Sci. nat. Belg.*, **27,** no. 39, 8). It had been doubtfully determined by BERNHAUER as '*S. rubellus* Epp. var. ?'.

DIPTERA: distribution, etc., of CULICIDAE, see SCOTT, 1927 *b*, and EDWARDS, 1928, p. 268; TABANIDAE, ASILIDAE, BOMBYLIIDAE, H. OLDROYD, 1940, *Ann. Mag. Nat. Hist.* (11), **5**, 192–203 (concerning the *doba* fly, possibly a Tabanid, said to occur in definite fly-belts across the main trade route from Addis Ababa to the Sudan and to cause disease in mules, see A. DUNLOP, 1937, p. 513, and note by H. SCOTT in the same article, p. 520); MUSCIDAE, i, F. I. VAN EMDEN, 1941, *Ann. Mag. Nat. Hist.* (11), **8**, 210–34; SPHAEROCERIDAE (BORBORIDAE), O. W. RICHARDS recorded four species collected by Omer-Cooper and myself in Jem-Jem Forest, and described a new one, *Leptocera scotti*, from the highest moorland of Mt. Chillālo, in a paper on 'Some African Sphaeroceridae', *Proc. R. Ent. Soc.* (B), **8**, 68–73, 1939; he has also described (1951, p. 841) a new wingless genus (*Lobeliomyia*) containing a single species found in a decaying stem of *Lobelia rhynchopetalum* on Mt. Chillālo in 1926, while a new species of the wingless genus *Binorbitalia*, discovered on Mt. Tola in 1948, will shortly be published in the Linnean Society's *Journal*. No other families of the numerous flies collected have been worked out.

Work on certain families of insects, especially Coleoptera, is continuing, and further Reports should appear, based in each case on the material obtained in 1948–9 as well as that collected in 1926–7. The same may (I hope) apply to the considerable numbers of MYRIOPODA and ARACHNIDA collected in 1926–7. The former are still undetermined, while no Report on the latter has appeared except that on aquatic mites (Hydracarina) listed above in Omer-Cooper's series. The identification of the spiders was undertaken by a specialist since deceased, who described a number of new species, but whose Report remains unpublished. The PHALANGIDEA (OPILIONES or 'harvestmen') have been named.

(2) *References.*

NOTE.—References to works cited only once, and bearing on side-issues rather than the main theme, are given in full in the text and not repeated here. Also, though some travel books and other general works on Ethiopia and adjacent countries are necessarily included, this list has no pretension to be a full bibliography.

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* I am indebted to the Editorial staff of *Country Life* for letting me consult their office file, as no spare copies of this issue escaped destruction during the War.

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Setaria pallide-fusca (Schumach.) Stapf et Hubbard, 136.
Solanum indicum L., 128.
Solanum melongena L., 122, 129.
Solanum muricatum Ait. 129.
Sorghum sp., 125, 158–9,
Sporobolus phyllotrichus Hochst., 129.
Swertia lovenii Th. Fr. jr., 134, 144, 149.
Swertia lugardae Bullock, 150.
Tephrosia interrupta Hochst. et Steud. ex
Swertia kilimandscharica Engl., 133.
Chiov., 134, 155.
Trifolium petitianum A. Rich., 120.
Trifolium simense Fresen, 120.
Uebelinia sp., 144.
Vicia sativa L., 139.
Viola abyssinica Steud., 135, 148.
Wahlenbergia silenoides Hochst. ex A. Rich., 138.
Zizyphus sp., 125.

LIST OF MAPS AND FIGURES IN TEXT.

(For the sources from which the maps are adapted, see p. 109.)
Folding route-map opposite p. 110.

FIG. 1.—Relation of the high mountains of southern Ethiopia and eastern Africa to the Rift-Valley System (adapted from J. W. Gregory, 1921) ; p. 96.
FIG. 2.—Montane species of *Trechus*. Left to right, *T. gugheensis* (Gughé Highlands) ; *T. culminicola* and *T. chillalicus* (both from Mt. Chillālo) ; all ×15 ; p. 99.
FIG. 3.—*Cryptorites scotti* a minute depigmented beetle with only slight vestiges of eyes, living in the soil, ×55 ; p. 101.
FIG. 4.—Distribution of rainfall in Ethiopia, Eritrea and Somaliland ; p. 111.
FIG. 5.—The *enseté*-tree (from James Bruce, 1790) ; p. 131.
FIG. 6.—Map of country traversed from Borodda to Ghidolé (on larger scale than in route-map) ; p. 145.
FIG. 7.—The Arussi memorial stone seen in Pl. 42, showing different designs on the west (left) and east sides (drawn from the author's photographs) ; p. 173.

EXPLANATION OF PLATES 3–28

NOTE.—All the 47 photographs here reproduced are from my own exposures (though one of my men pressed the wire-release in two scenes where I appear). All but three were taken with a Rolleiflex Camera, and are enlarged from negatives $2\frac{1}{4}$-inches square. The three exceptions are the lower photographs on Pls. 6, 11 and 19 respectively, which were re-photographed after my return from my Dufay-Chromex colour-transparencies.

I used Ilford 'Selo' films (hypersensitive, panchromatic) and a Weston Master Universal Exposure Meter, noting full details of the exposure in every case when there was time. In photographing panoramic views, vegetation, and in fact almost all still scenes, the camera was set on its stand, the smallest stops were used and correspondingly longer exposures given, while a yellow light-filter was generally added, doubling the exposure.

As to the difficult atmospheric conditions mentioned on p. 87, I was prepared for plenty of cloudy skies, but not for the thick haze overhanging Lake Chamo in December and January, to penetrate which would have required either a deep orange filter, or an infra-red filter and appropriate films.

I would that more time had been available for 'close-up' work ; as it is, the only photographs here reproduced in which Proxar lenses were used are the flower-subjects on Pl. 3.

Plate. 3. Above, *Delphinium wellbyi*, freshly gathered, at Addis Ababa, September.
Below, *Craterostigma pumilum* (height about two inches), north of Addis Ababa, late August.

Plate. 4. Above, the Makki River, west of the bridge, October; *wanza*-tree (*Cordia abyssinica*) covered with white flowers.
Below, part of a herd under care of Arussi boys in acacia-scrub north of the Hawash bridge.

Plate 5. Above, tomb of an Arussi chief, surrounded by memorial stones, west of Shashamanna; *quolquol*-trees (*Euphorbia candelabrum*) behind.
Below, large acacia marking frontier between Arussi and Kambāta provinces.

Plate 6. Above, grass-thatched house of Wolāmo type at Shoné.
Below, Wolāmo 'houses of the dead' surmounting graves on Mt. Damōta; the man's grave (left) is distinguished by the stick projecting up from the top.

Plate 7. Above, old reservoir made by damming a shallow valley at Bulghita, Shoné.
Below, battery of cylindrical thatched beehives near the Makki bridge.

Plate 8. Left, conical thatched beehive placed singly (the more usual method) in a tree (*Dracaena*) at Sōddu.
Right, Wolāmo schoolboys at Sōddu; the boy on left wears an ear-ring in the right ear only.

Plate 9. Left, woman at Ezo digging 'Galla potatoes' (*Coleus edulis*) with two-pronged mattock.
Right, Wolāmo musicians near Sōddu, summoned to a funeral.

Plate 10. Left, Gamo woman at Bonghé winding cotton (the building shown is a granary).
Right, itinerant weavers of cotton at Ghidolé market.

Plate 11. Above, south face of Mt. Damōta, from the Sudan Interior Mission station at Sōddu.
Below, north-west from highest summit of Mt. Damōta, showing secondary crater with groves of bamboo and plantations of *enseté*.

Plate 12. Above, view east to Lake Abaya from track between Borodda and Ezo, November.
Below, east from above Ochollo, showing Lake Abaya (left) and Lake Chamo, and 'God's Bridge'.

Plate. 13. Gughé Highlands; Mt. Tola from the east, with the sun declining behind the highest escarpment.

Plate 14. Mt. Tola, north part of eastern escarpment; narrow terraces of young barley (early December) and bamboo groves.

Plate 15. View south-east from top of Mt. Tola; in the background the lakes and the mountains of Sidāmo.

Plate 16. Above, *Lobelia giberroa* in cultivated ground between Chencha and Ochollo (November).
Below, west face of Mt. Tola from the Bonghé valley; in foreground seven-foot cabbages, young *enseté*-trees on right (December).

Plate 17. Above, the twin peaks of Mt. Gughé, seen under a lowering sky from the high camp on Mt. Tola.
Below, a sacred spot between Borodda and Ezo; strands of cotton stretched between the branches of the euphorbia; the muleteer has just added a stone to the heap.

Plate 18. Left, Bonghé valley, a bamboo grove in a ravine with a waterfall at the head; fenced field of barley in foreground (December).
Right, fruiting inflorescence of *Lobelia rhynchopetalum* on top of Mt. Tola (December); *Alchemilla haumannii* in foreground; Lake Abaya in distance.

Plate 19. Above, view south-west over peat-moorland from peaks of Mt. Gughé; *Dryopteris*-fern in left foreground.
Below, undergrowth of herbaceous *Alchemilla* in bamboo forest on Mt. Tola.

Plate 20. Southern Gughé mountains; harvesting barley, end of December; large *Podocarpus*-trees festooned with lichen; bamboo forest in background.

Plate 21. Above, sheaves of barley (torn up by the roots) laid in two ranks with ears facing.
Below, natural grove of date-palms (probably *Phoenix abyssinica*) amid grass and crops, north of Ghidolé, about 6,000 feet.

Plate 22. Above, the lower walled village of the Konso; cotton fields with low stone terraces in front.
Below, old man and girl of the Konso, near an open-sided house just within the wall of the upper village.

Plate 23. Left, Konso, basaltic memorial stones in the upper village.
Right, Borāna women at Yavello market.

PLATE 24. Above, tribeswomen at Mt. Jabasirri, north of Agheré Maryam.
Below, view eastward over high forests of Sidāmo (south of Fasaganat); flat-topped acacia in right foreground; mainly conifers (*Podocarpus*) in background.

PLATE 25. Tropical forest in Sidāmo, north of Agheré Maryam.

PLATE 26. Above, the larger pair of monoliths on Menelik's Hill, Sōddu (Wolāmo).
Below, group of monoliths north-east of Dilla, Sidāmo.

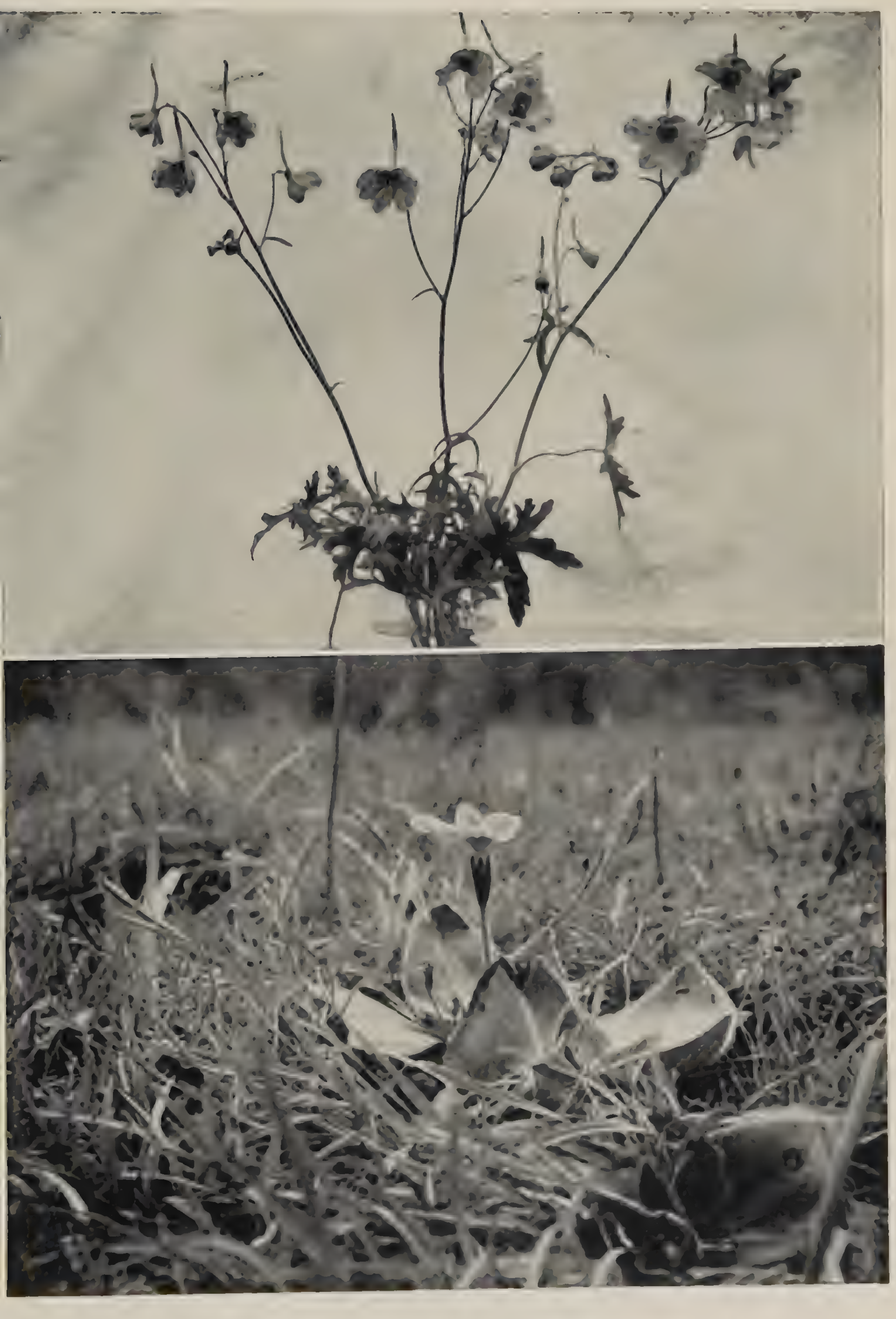
PLATE 27. Left, standing monolith at Watadera (Sidāmo); on left, a fallen column freshly broken to make a recent grave.
Right, an Arussi memorial stone and trophies, north of Shashamanna.

PLATE 28. Above, Arussi memorial stones, near Shashamanna.
Below, wayside tomb of a chief, with his son's grave behind on the right, east of Bulghita (Shoné).

Postscript.

(i) *Relative scarcity of the larger wild mammals* in the districts traversed: my remarks above (p. 124) are in general borne out by Captain *D. S. SORRELL* in a recent article (Wild life in Southern Ethiopia. Aug. 1952. *Oryx, Journal of the Fauna Preservation Society*, **1**, No. 6, 285-90).

(ii) *Lack of plantations of the qāt-tree in the districts visited*: my statements that I saw no plantations, and no persons chewing the leaves except a lorry-driver and his mechanic, who had probably brought their bunch of twigs from the Harar district, agree with the observations of *Mr. D. W. A. PETERS* (Khat, its history, botany, chemistry and toxicology. *Pharmaceutical Journal*, 5 and 12 July, 1952); he states that in Ethiopia the use of this plant is almost entirely confined to Muslims, and is very frequent in Harar.



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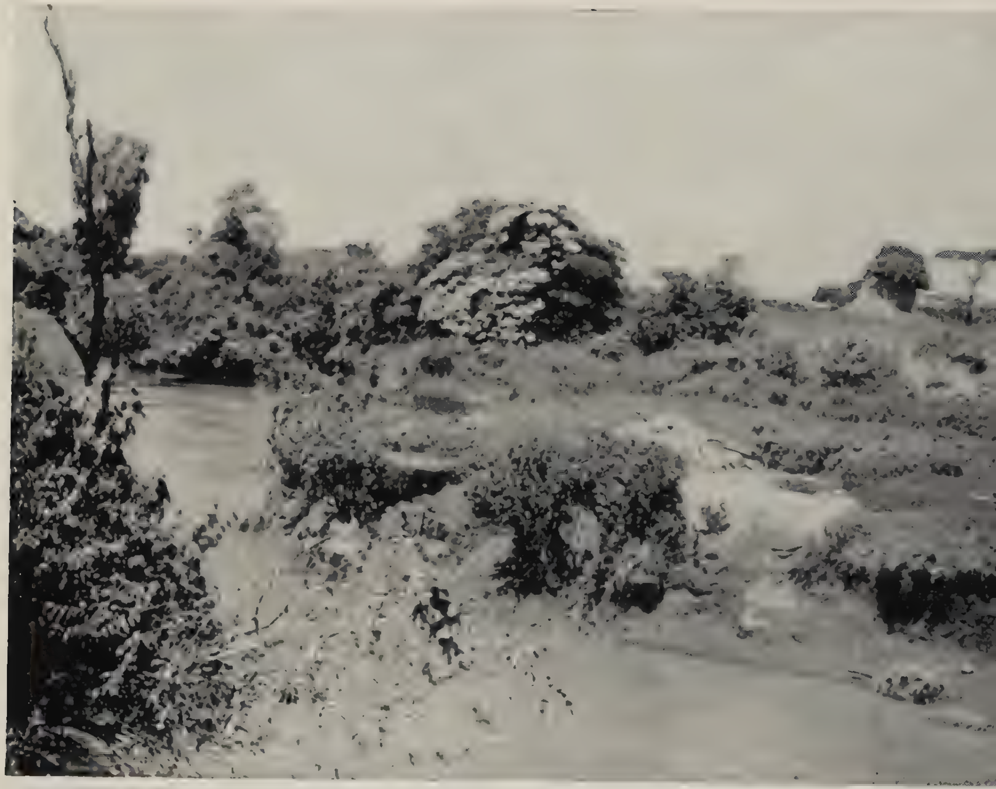

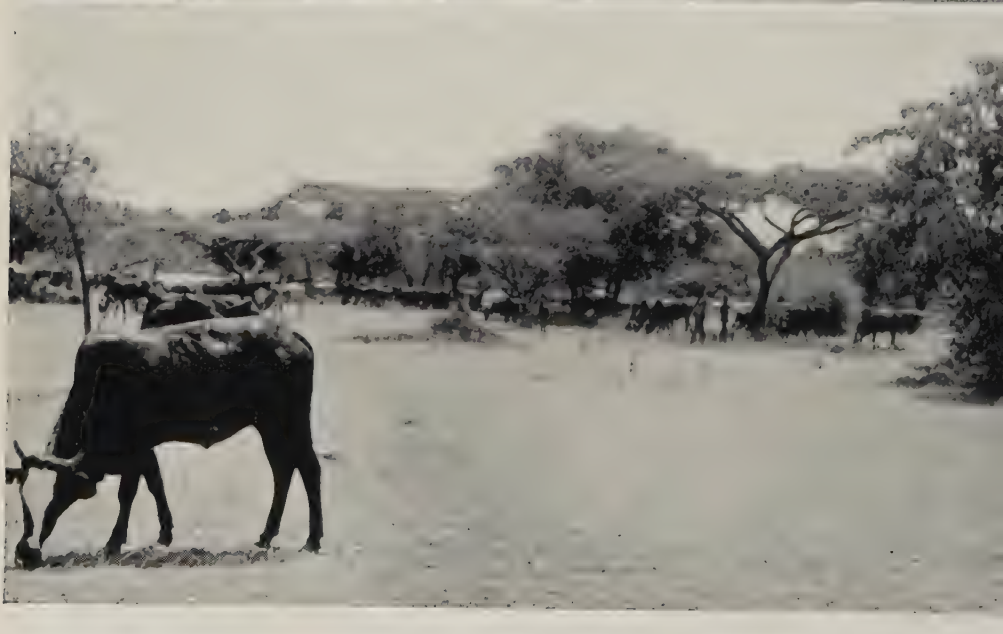

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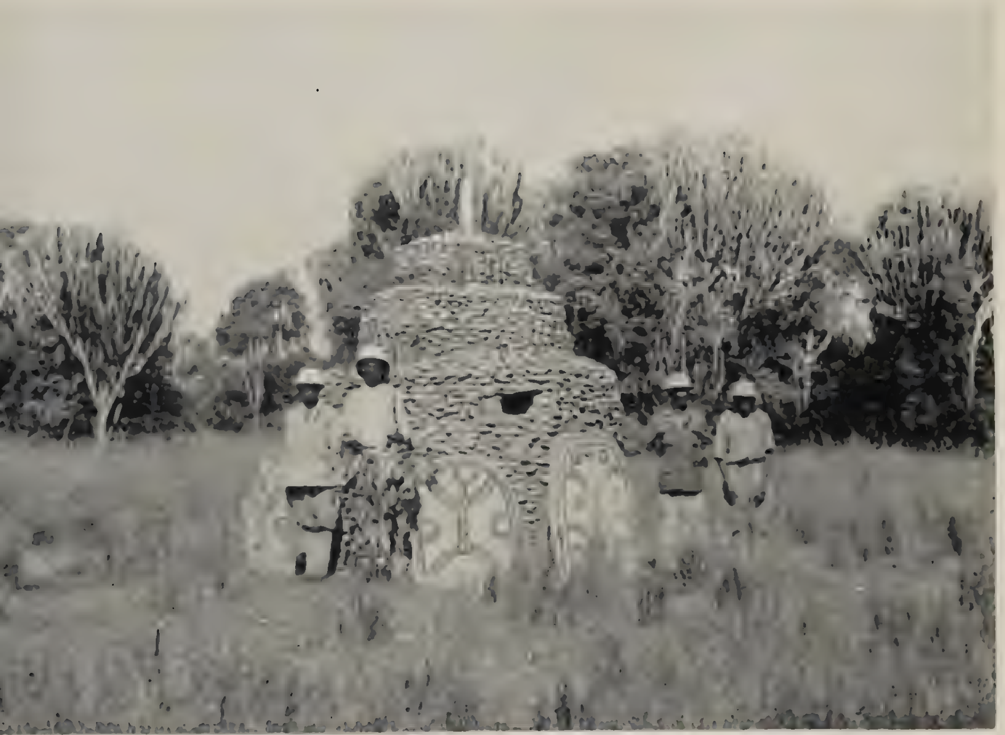

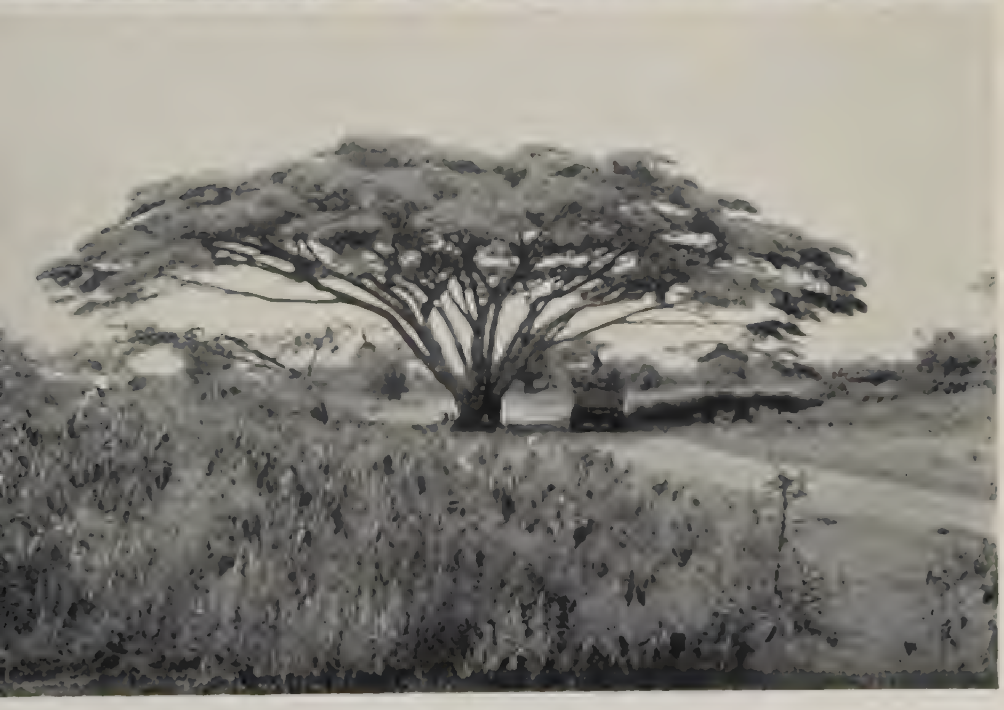

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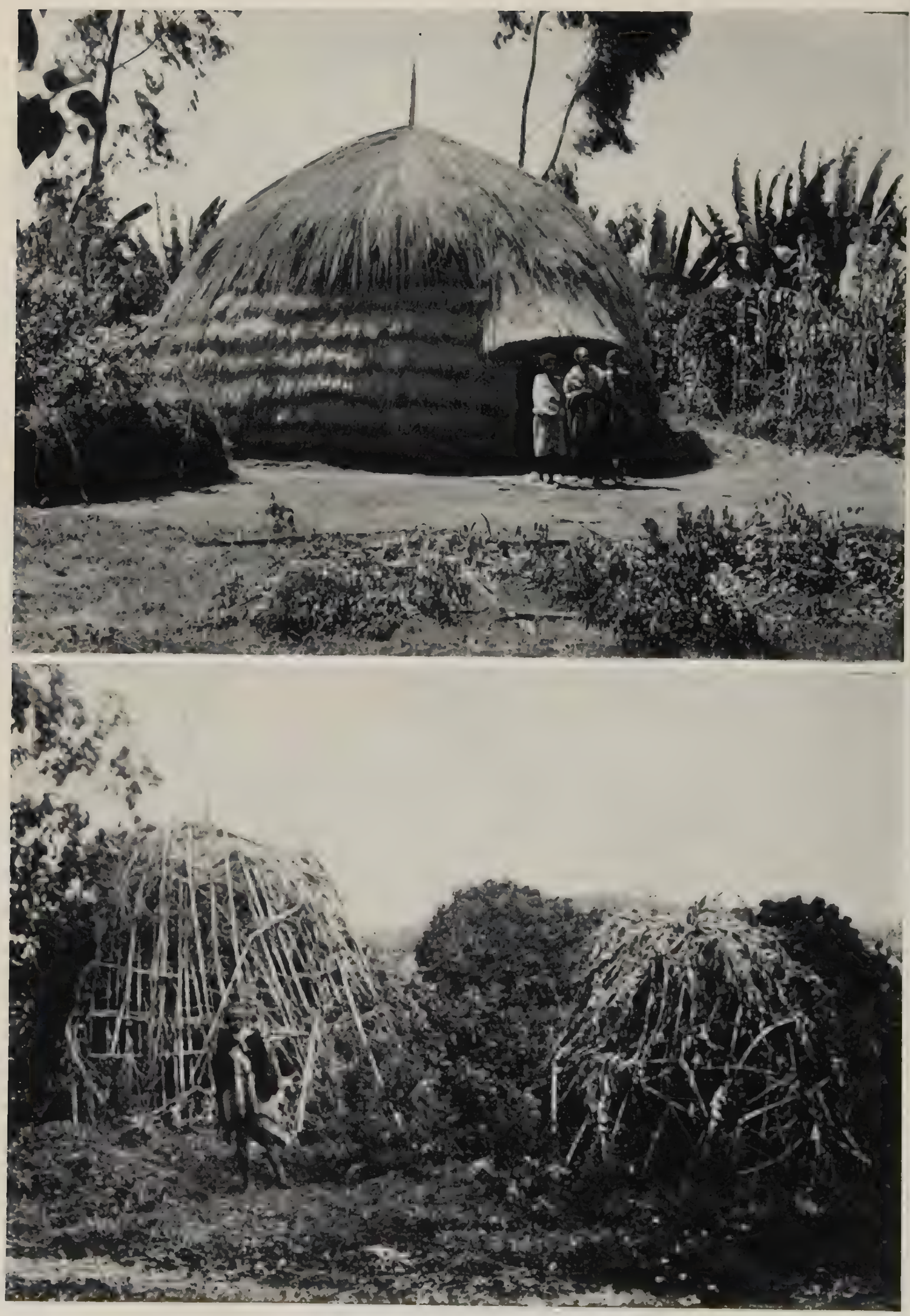
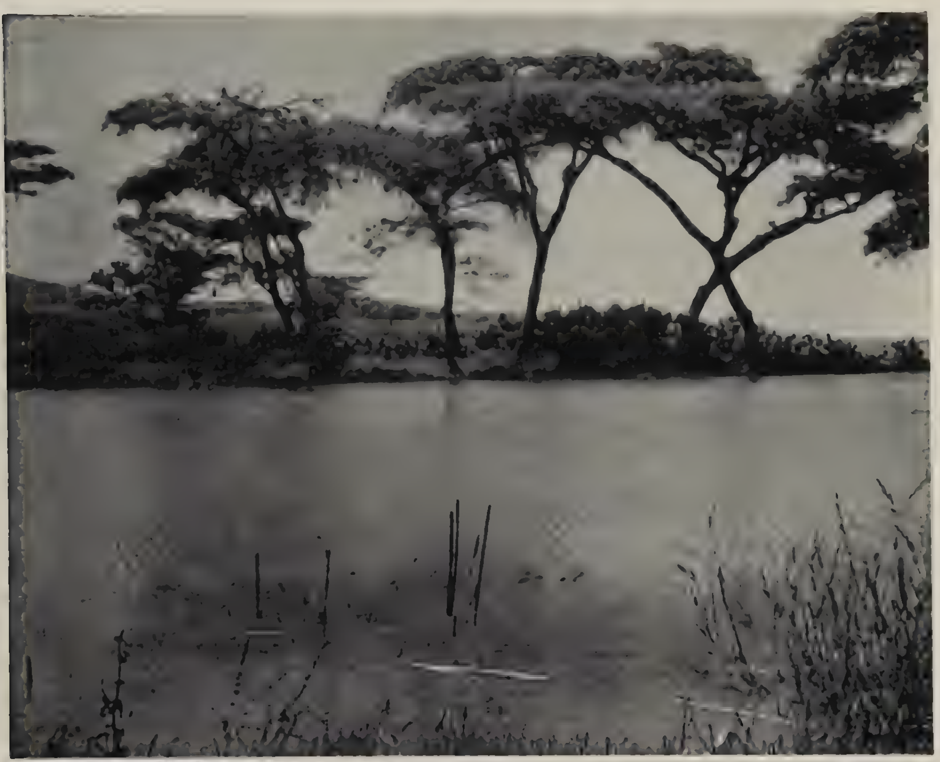
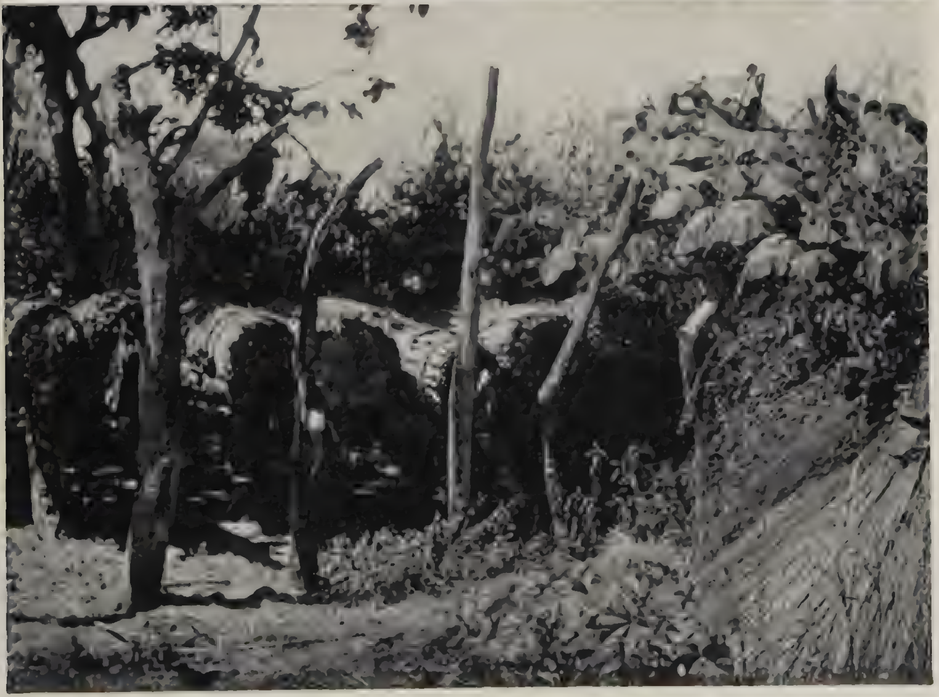


Above, grass-thatched house of Wolāmo type at Shoné.
Below, Wolāmo ‘houses of the dead’ surmounting graves on Mt. Damōta ; the man's grave (left) is distinguished by the stick projecting up from the top.





Above, old reservoir made by damming a shallow valley at Bulghita, Shoné.
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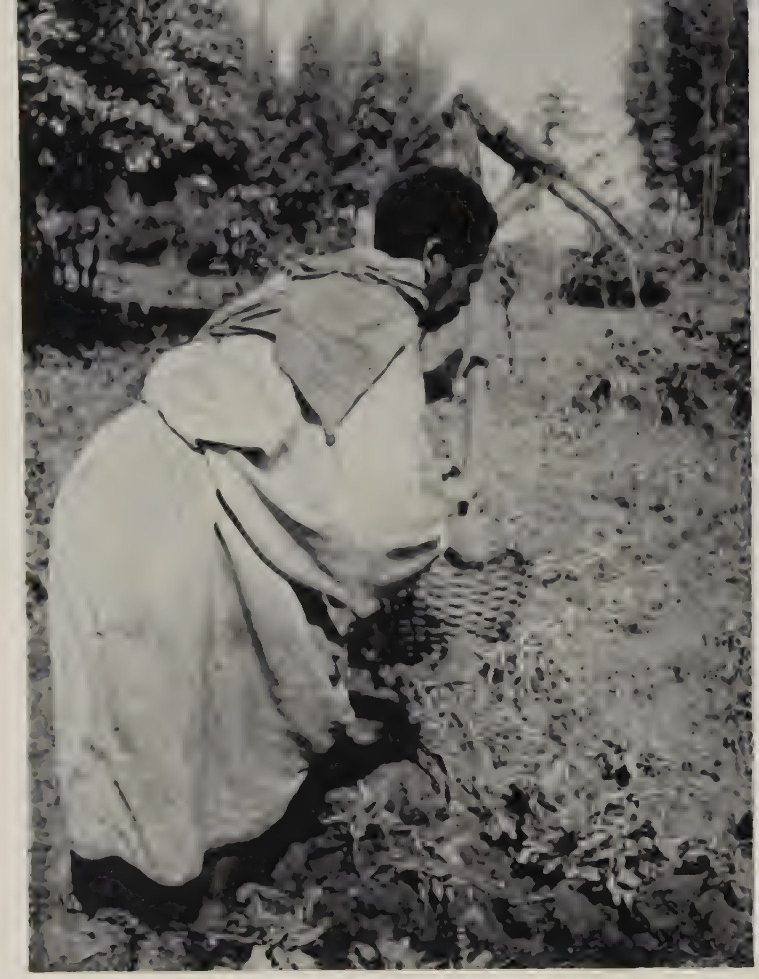
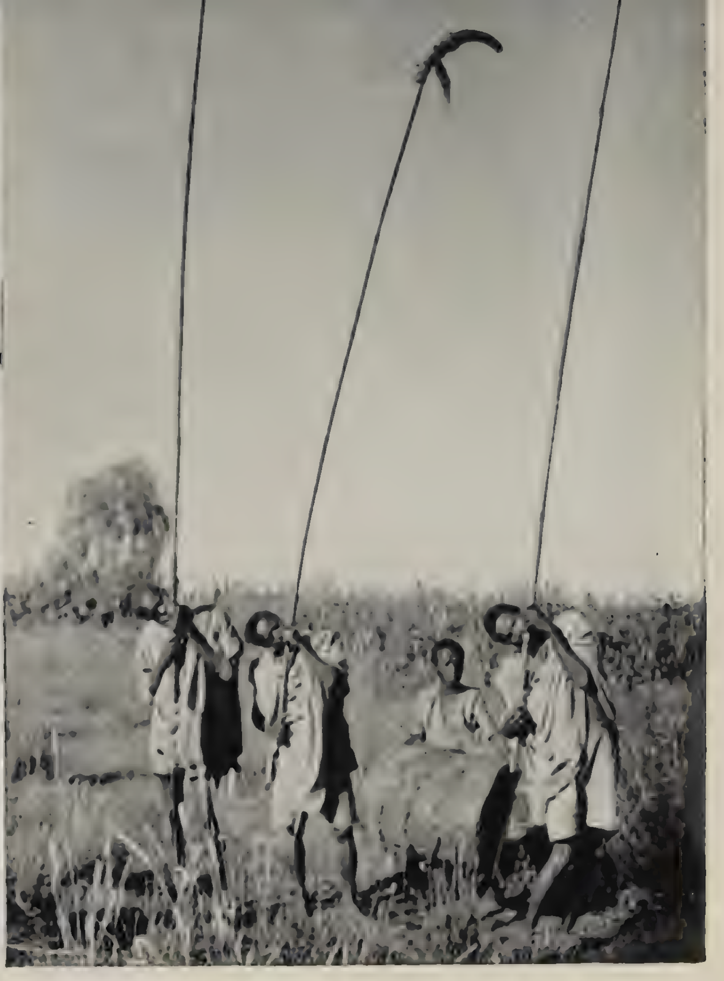
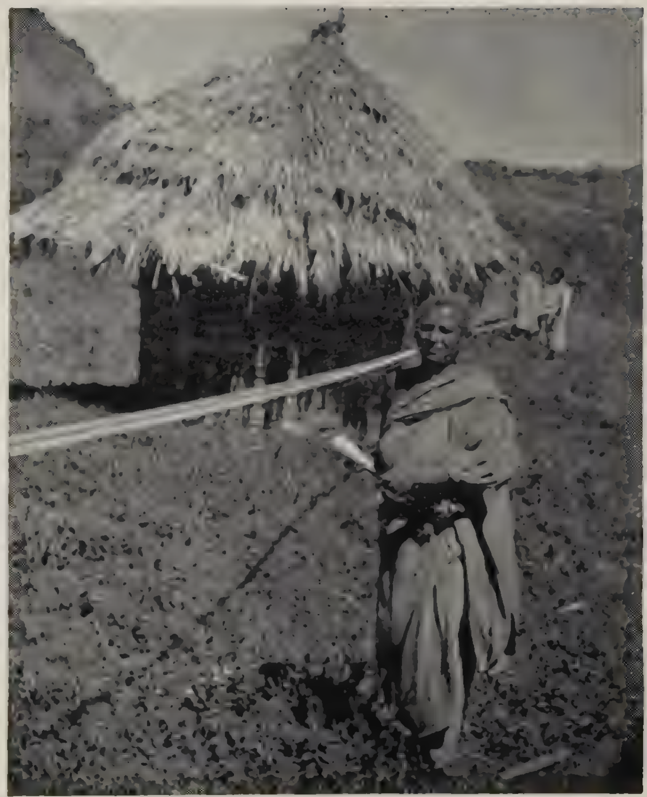


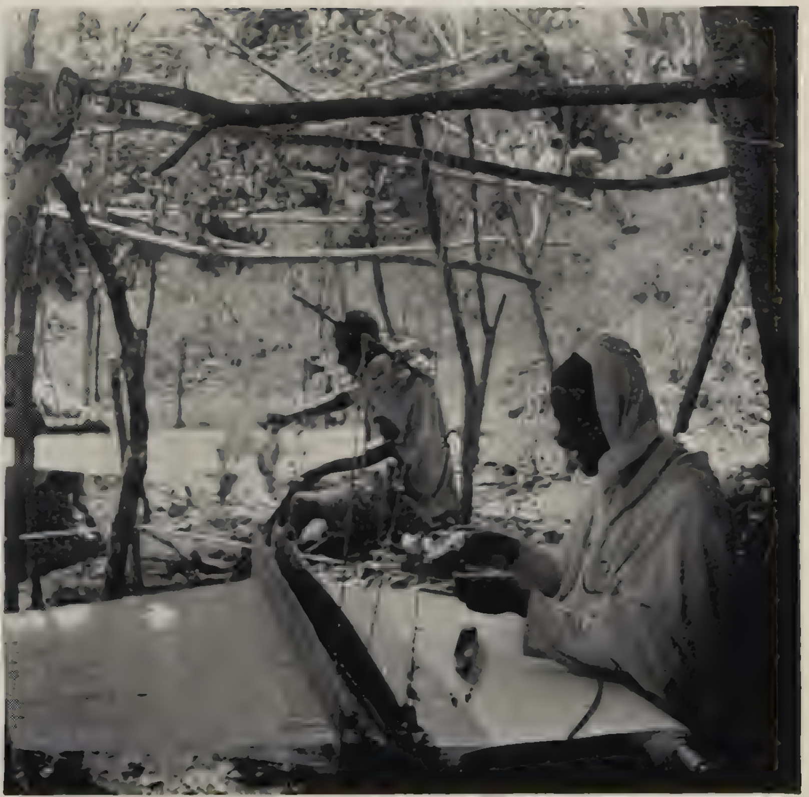
Woman at Ezo digging 'Galla potatoes' (*Coleus edulis*) with two-pronged mattock.



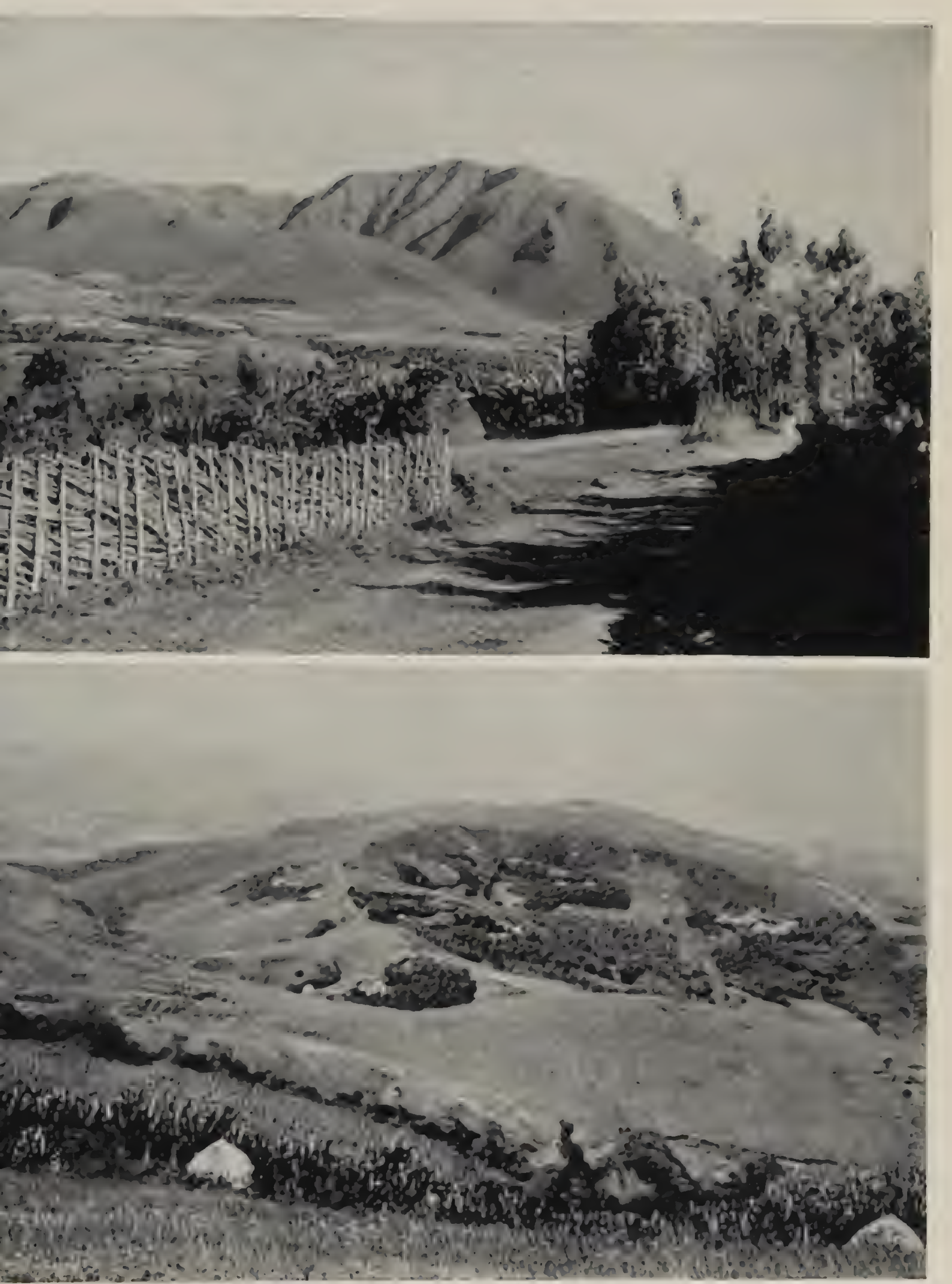
Wolámo musicians near Soddu, summoned to a funeral



Gamo woman at Bonghé winding cotton (the building shown is a granary).



Itinerant weavers of cotton at Ghidolé market.



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Below, north-west from highest summit of Mt. Damōta, showing secondary crater with groves of bamboo and plantations of *enseté*.

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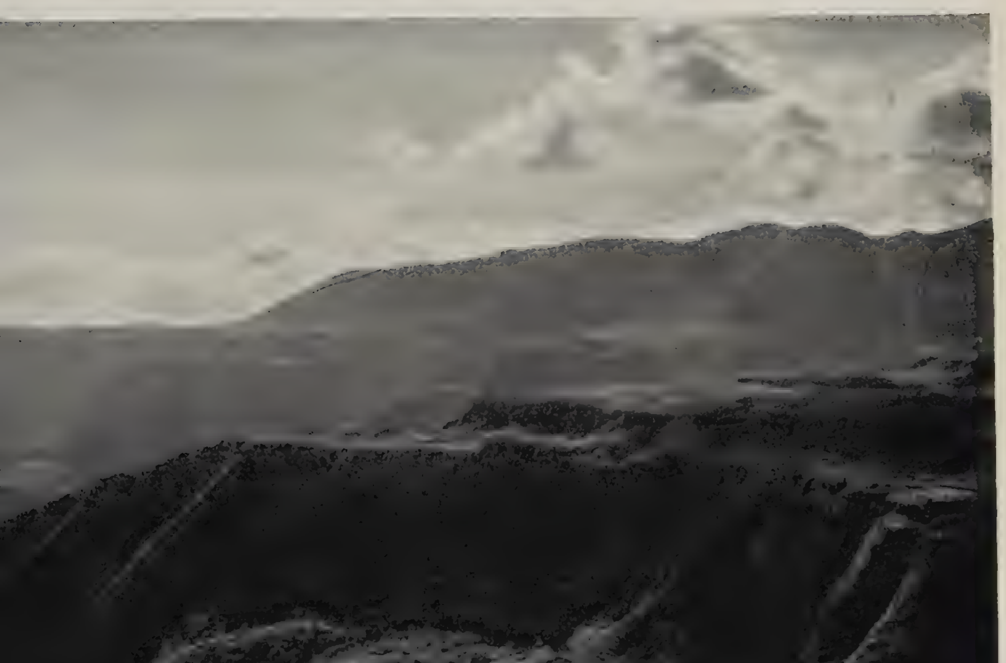
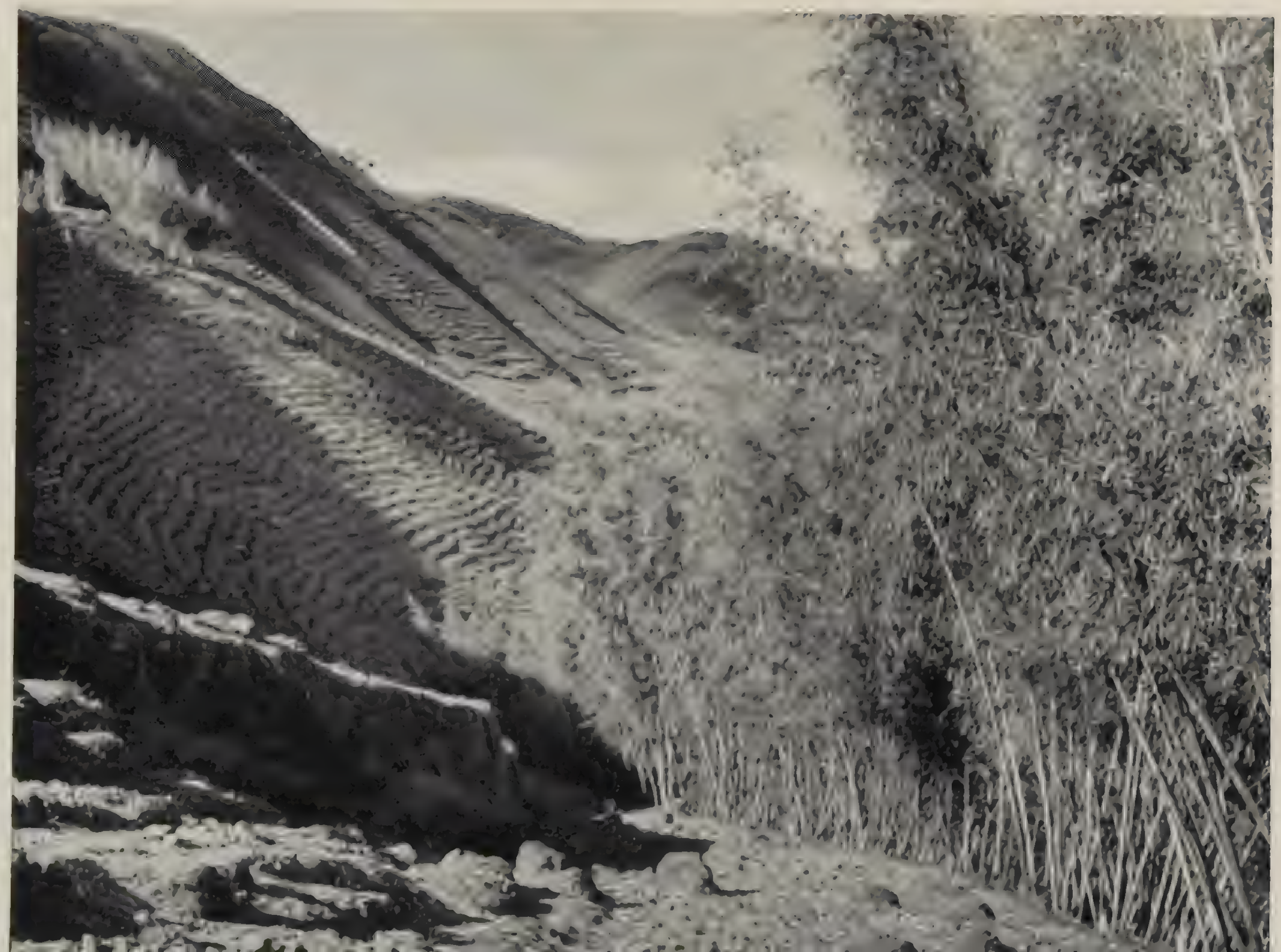
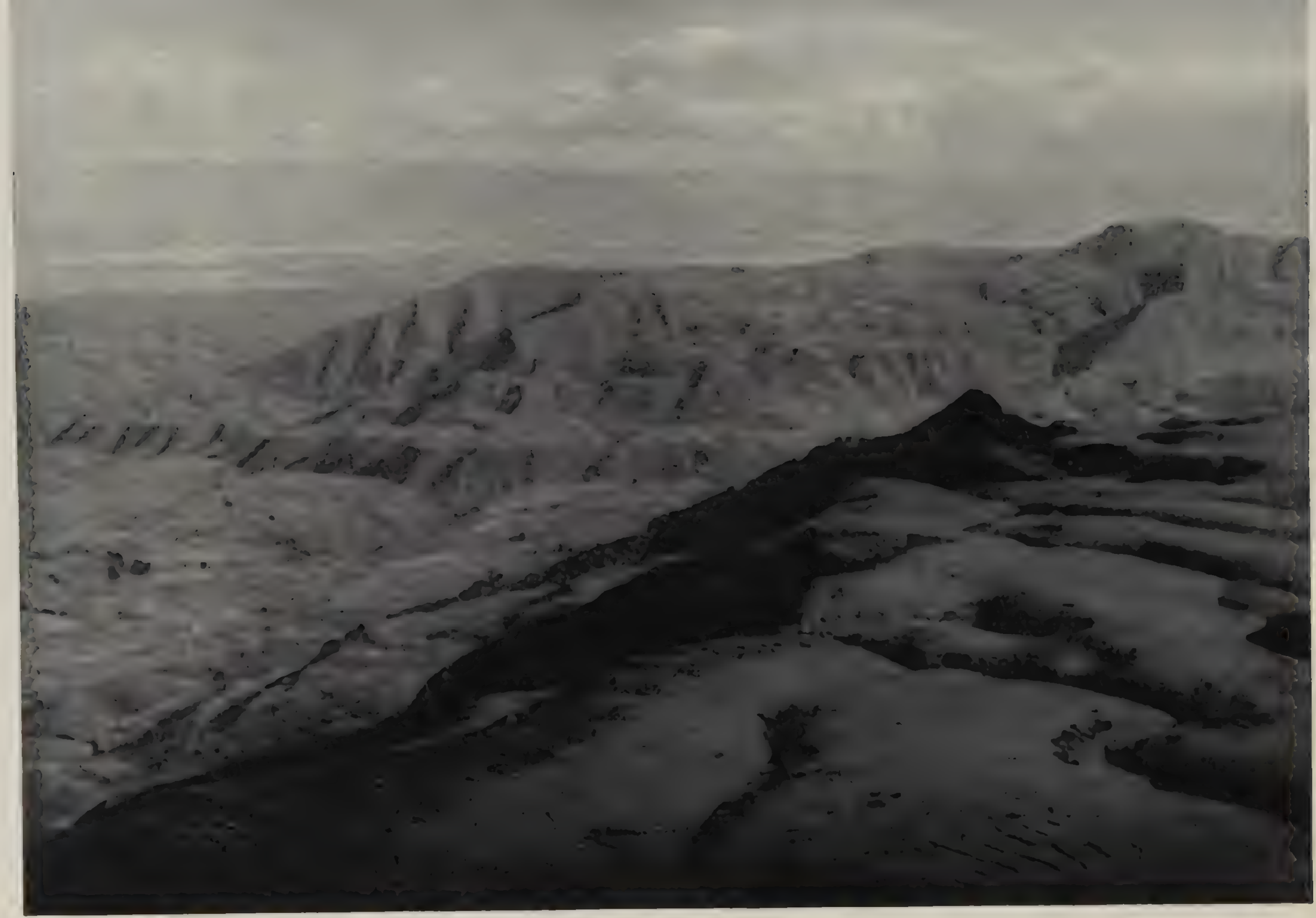
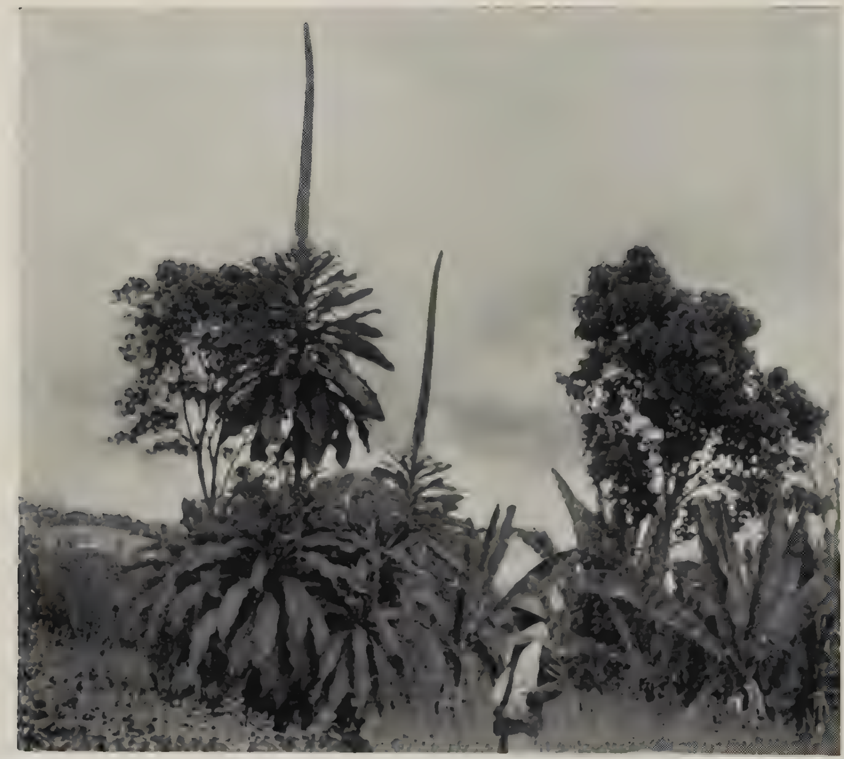


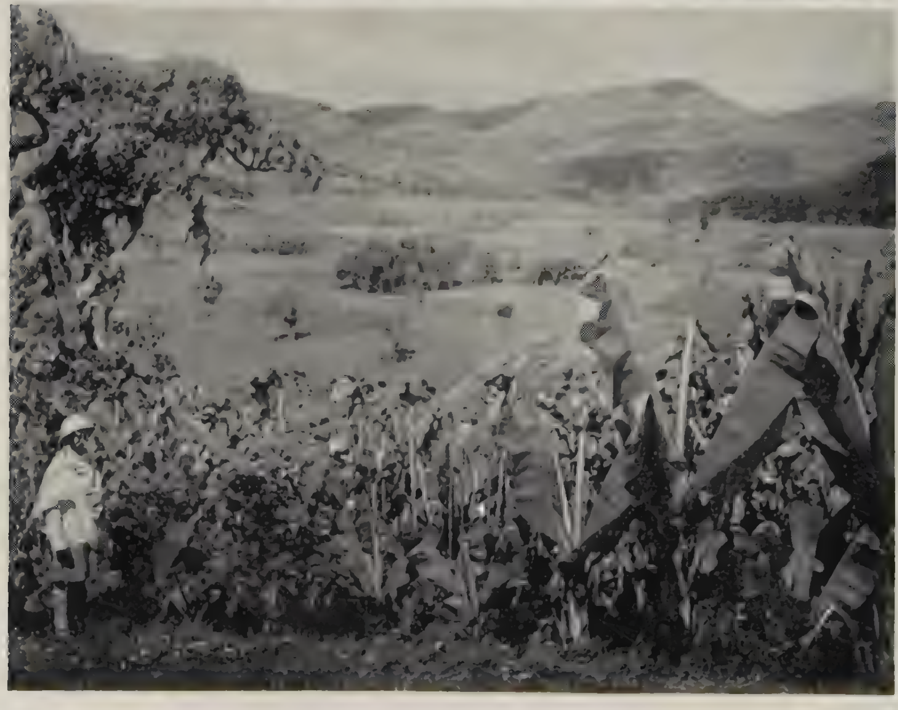
Gughé Highlands ; Mt. Tola from the east, with the sun declining behind the highest escarpment.





View south-east from top of Mt. Tola ; in the background the lakes and the mountains of Sidāmo.





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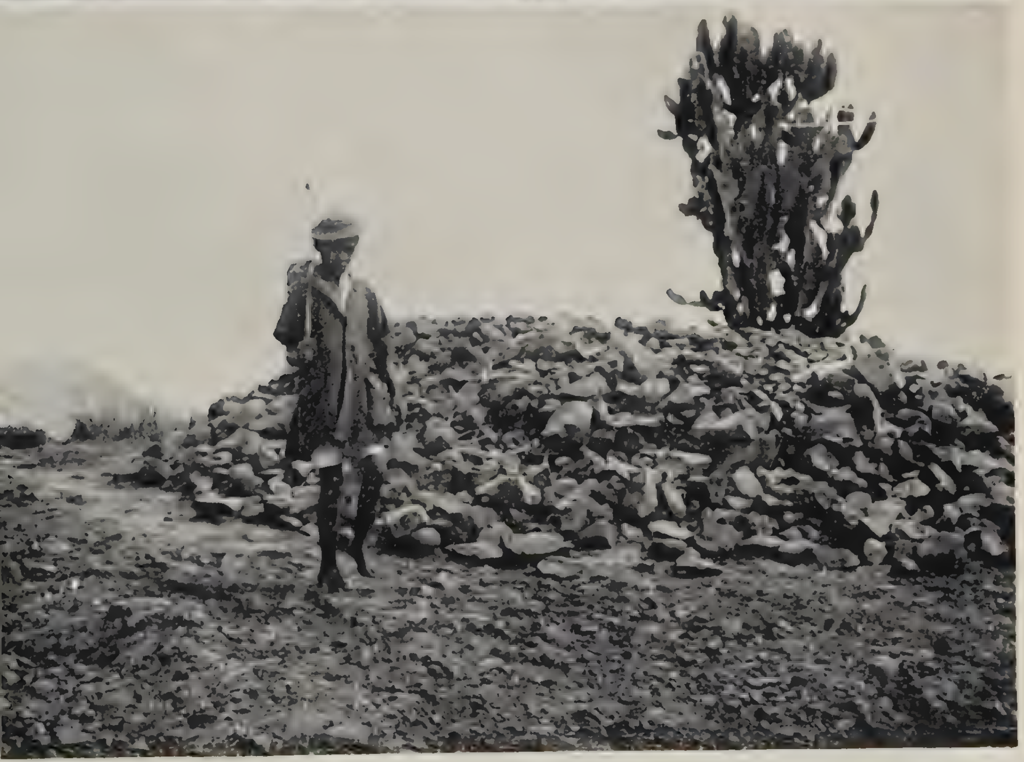
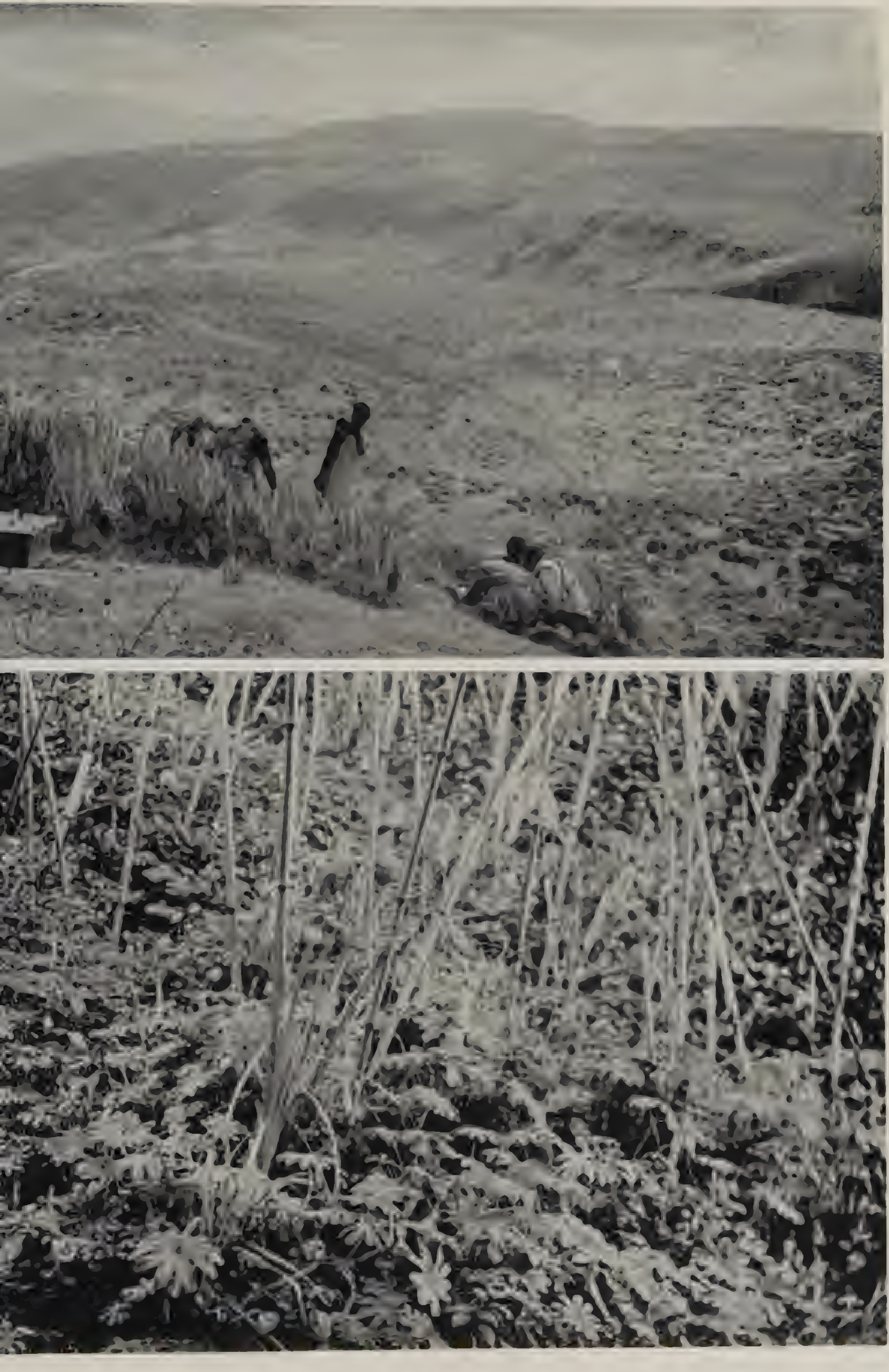


Above, the twin peaks of Mt. Gughé, seen under a lowering sky from the high camp on Mt. Tola. Below, a sacred spot between Borodda and Ezo; strands of cotton stretched between the branches of the euphorbia; the muleteer has just added a stone to the heap.



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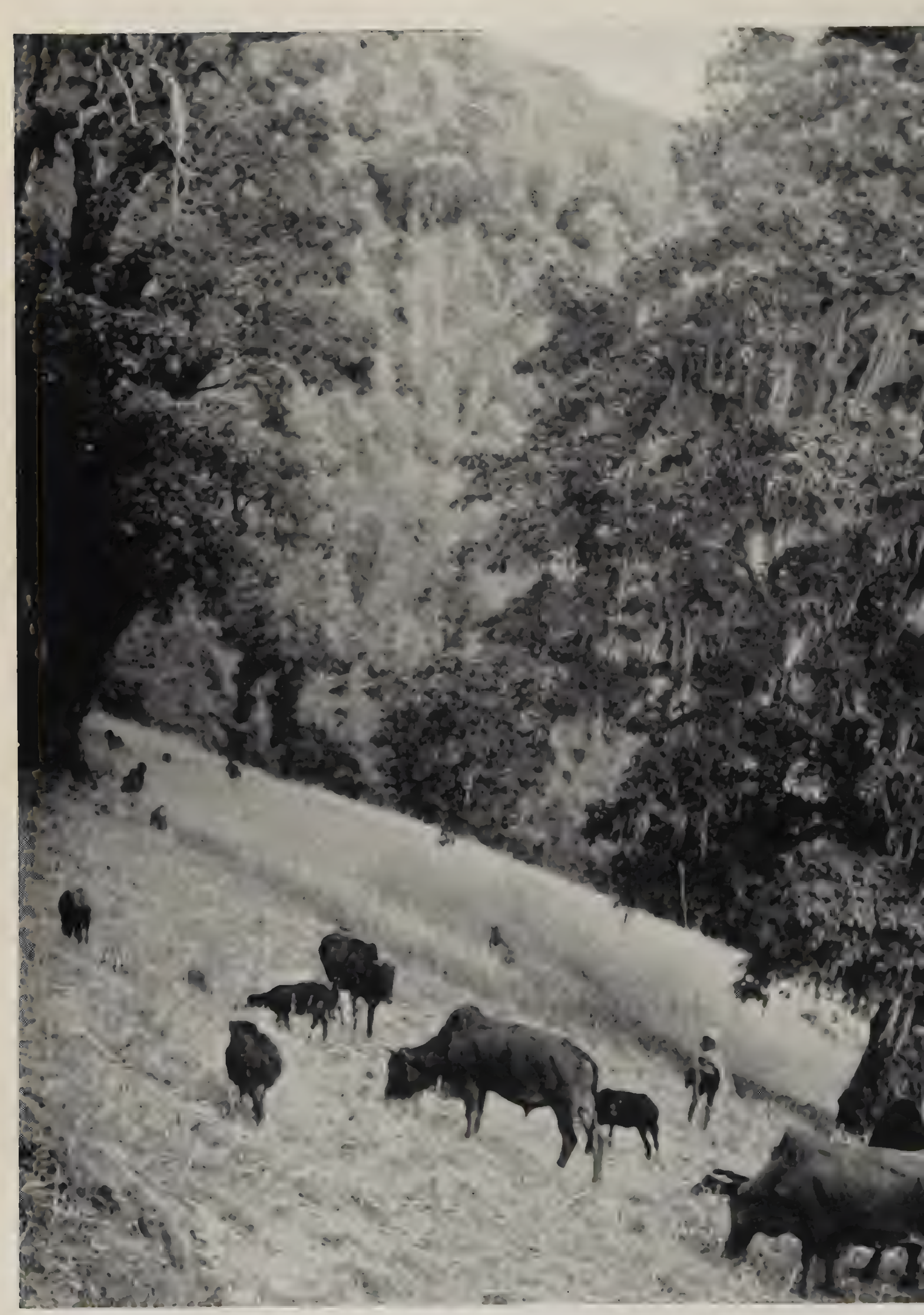
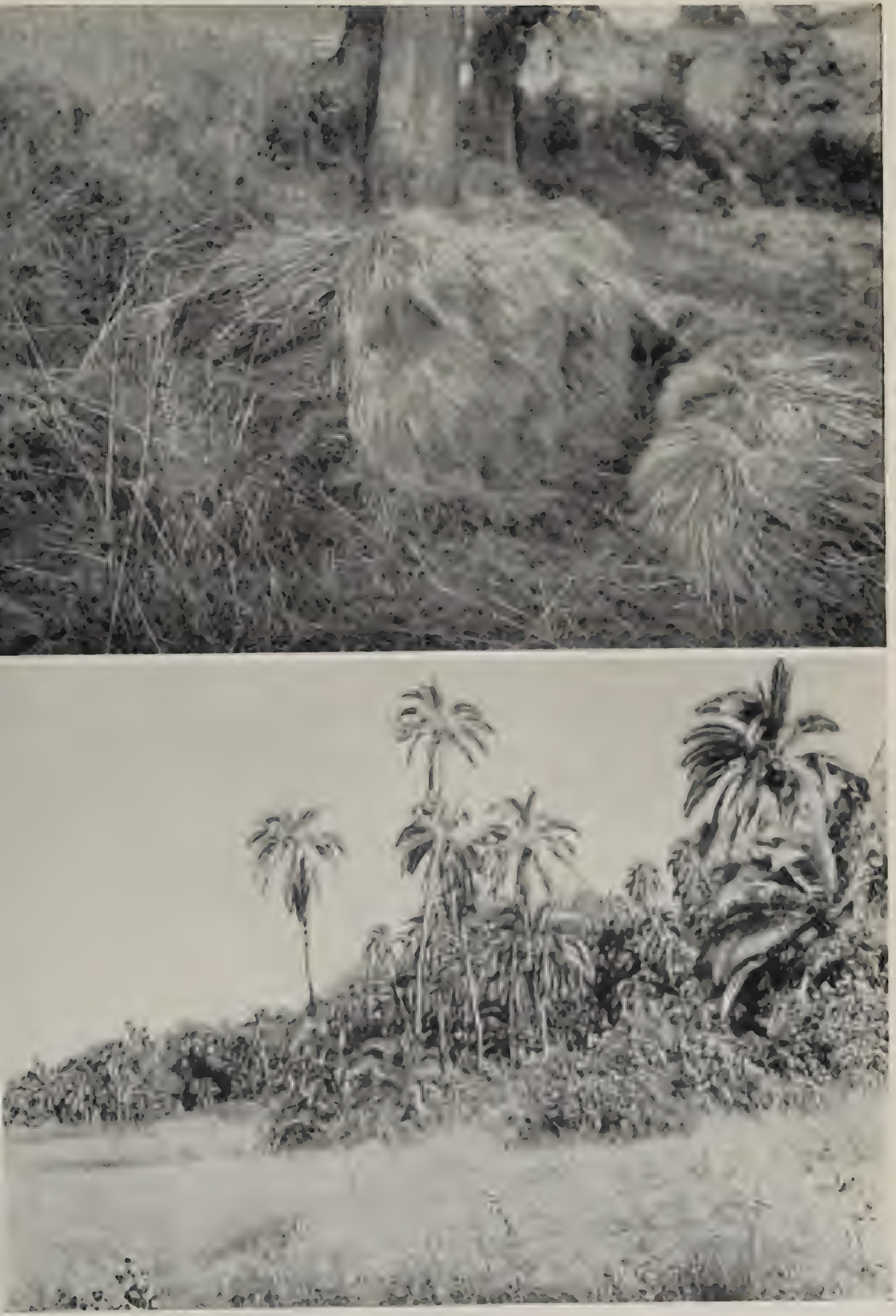
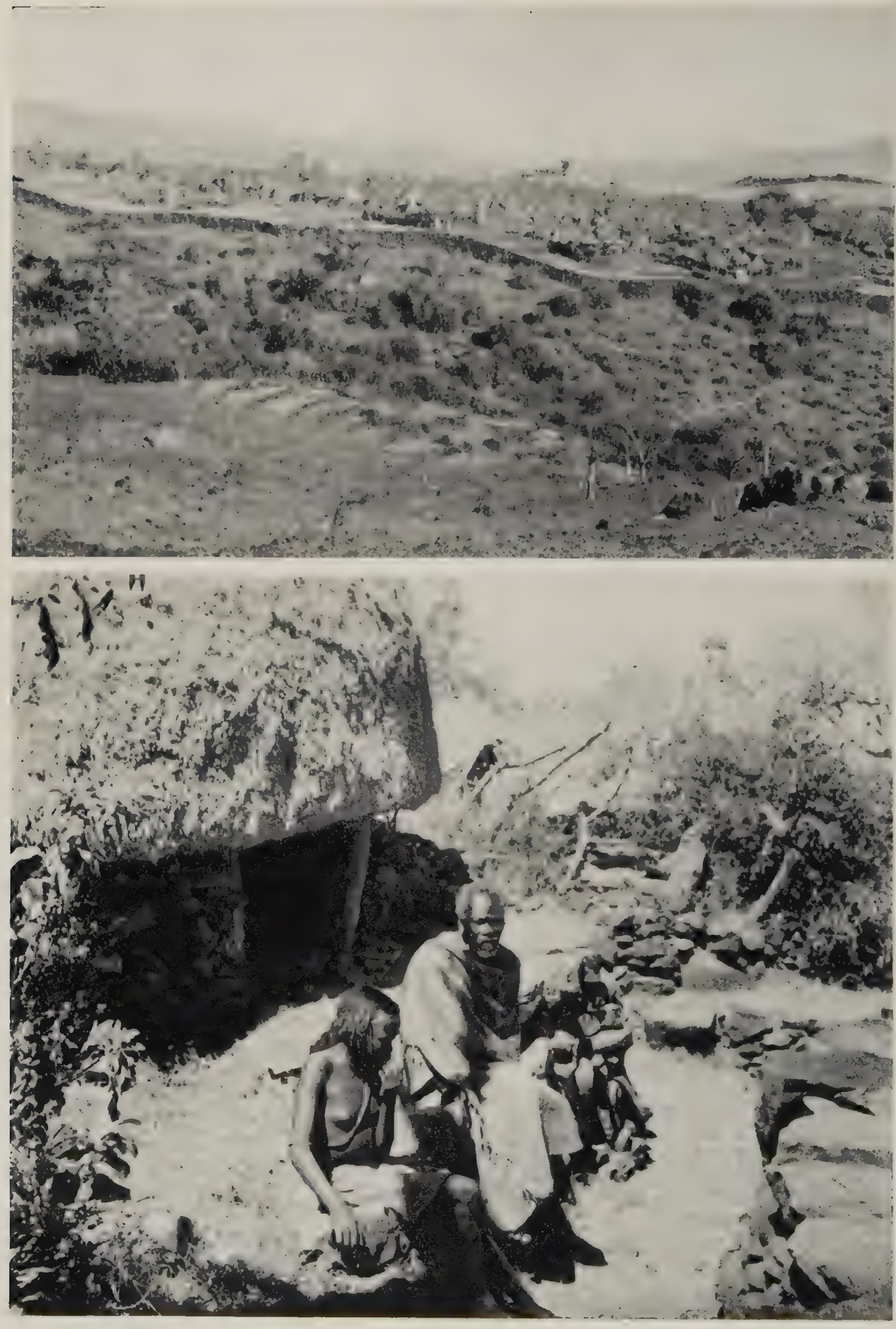


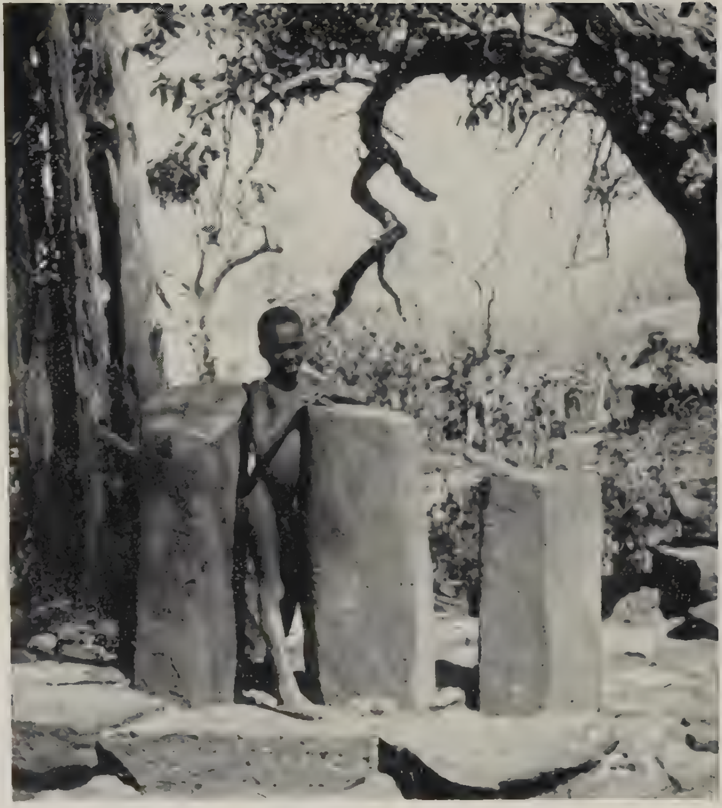
Southern Gughé mountains; harvesting barley, end of December; large *Podocarpus*-trees
festooned with lichen; bamboo forest in background.



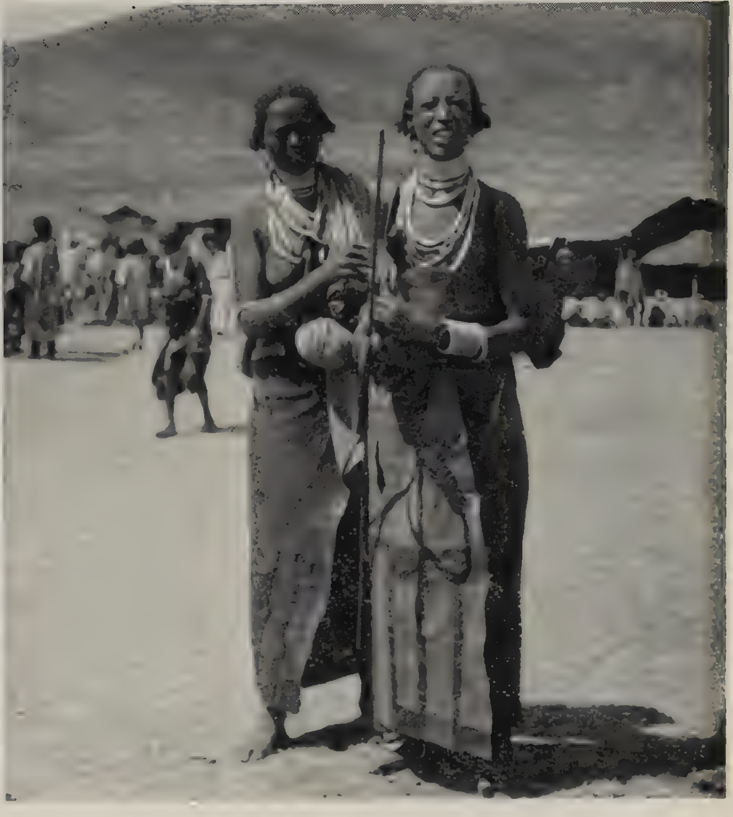
Above, sheaves of barley (torn up by the roots) laid in two ranks with ears facing.
Below, natural grove of date-palms (probably *Phoenix abyssinica*) amid grass and crops, north of Ghidolé, about 6,000 feet.



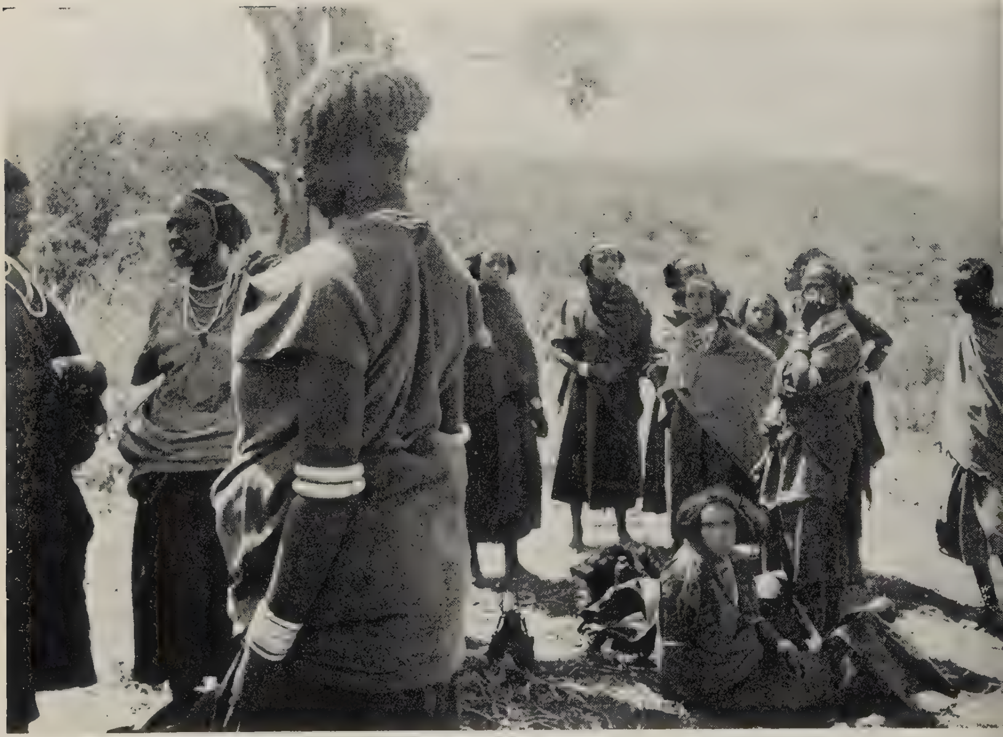
Above, the lower walled village of the Konso; cotton fields with low stone terraces in front. Below, old man and girl of the Konso, near an open-sided house just within the wall of the upper village.

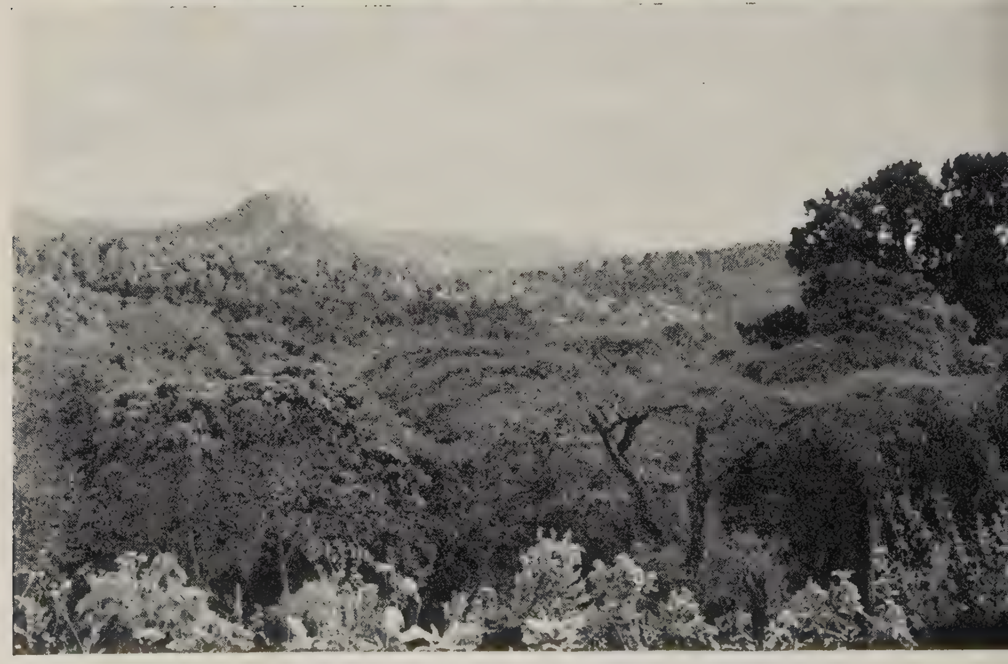


Konso, basaltic memorial stones in the upper village.

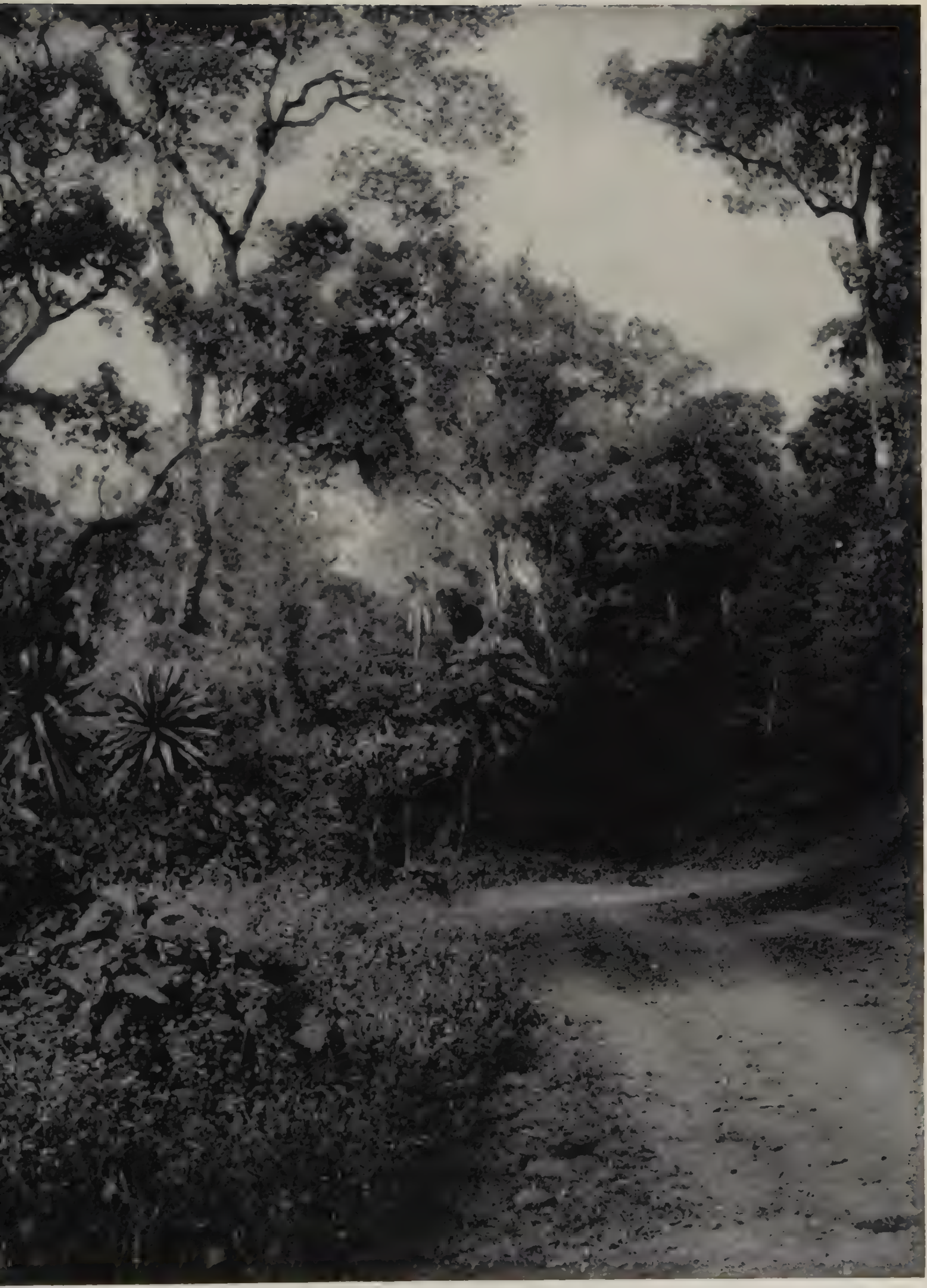


Borāna women at Yavello market.

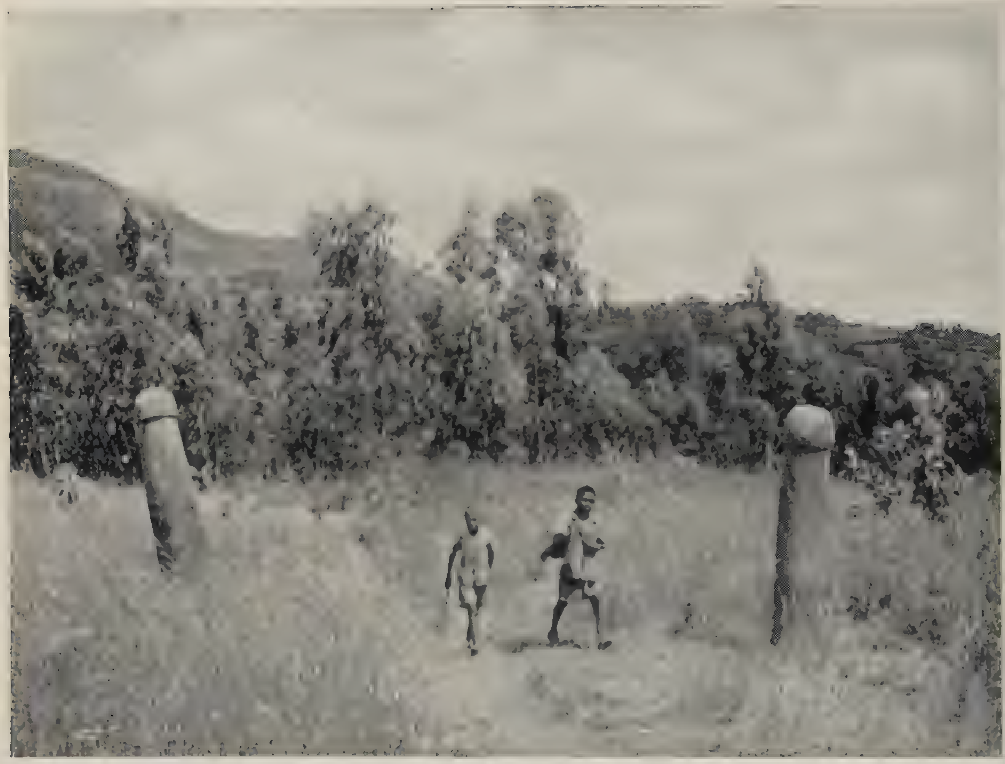


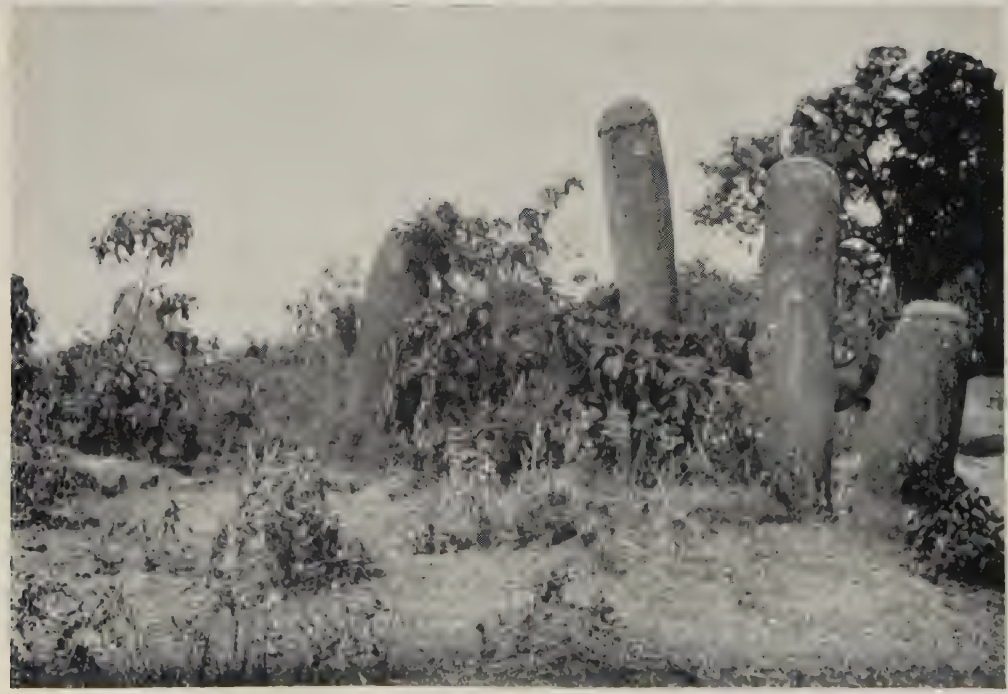


Above, tribeswomen at Mt. Jabasirri, north of Agheré Maryam.
Below, view eastward over high forests of Sidāmo (south of Fasaganat) ; flat-topped acacia in right foreground ; mainly conifers (*Podocarpus*) in background.

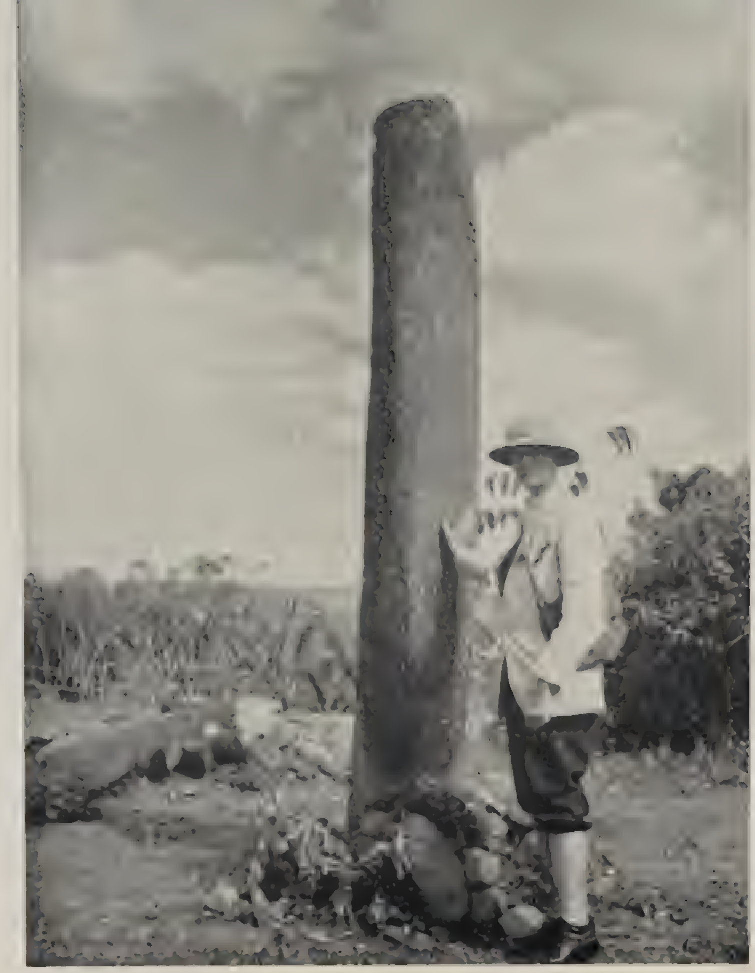


Tropical forest in Sidāmo, north of Agheré Maryam.

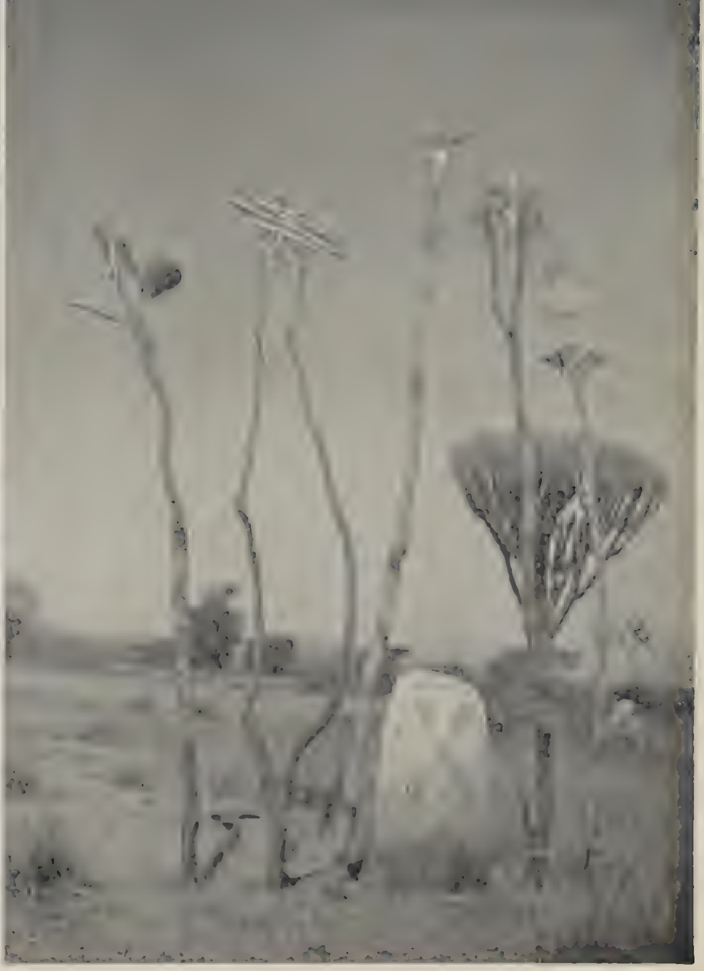




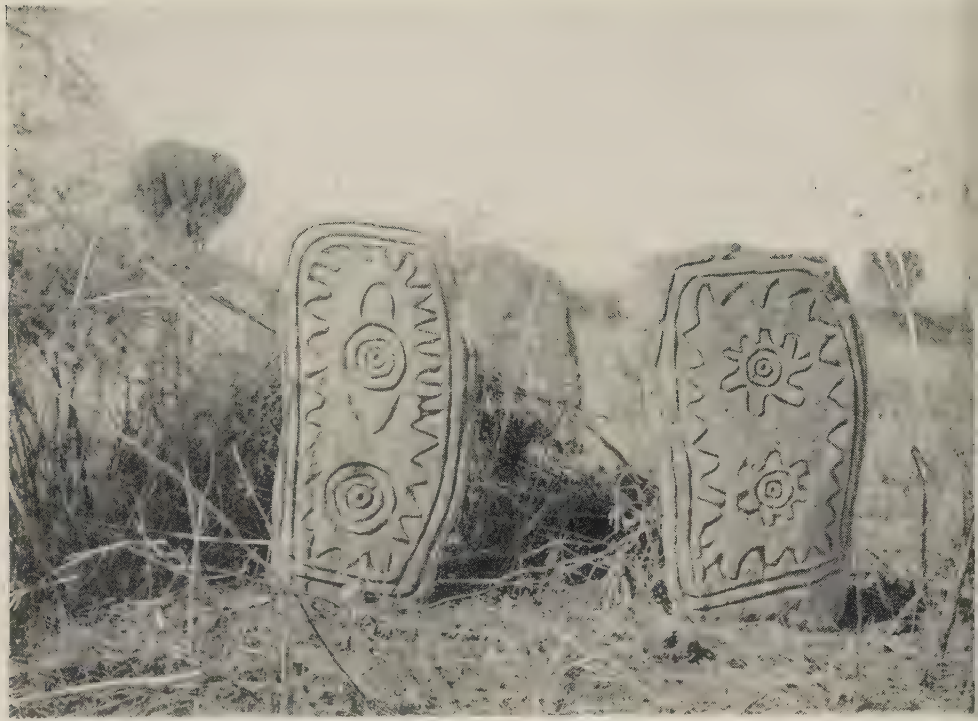
Above, the larger pair of monoliths on Menelik's Hill, Sōddu (Wolāmo).
Below, group of monoliths north-east of Dilla, Sidāmo.

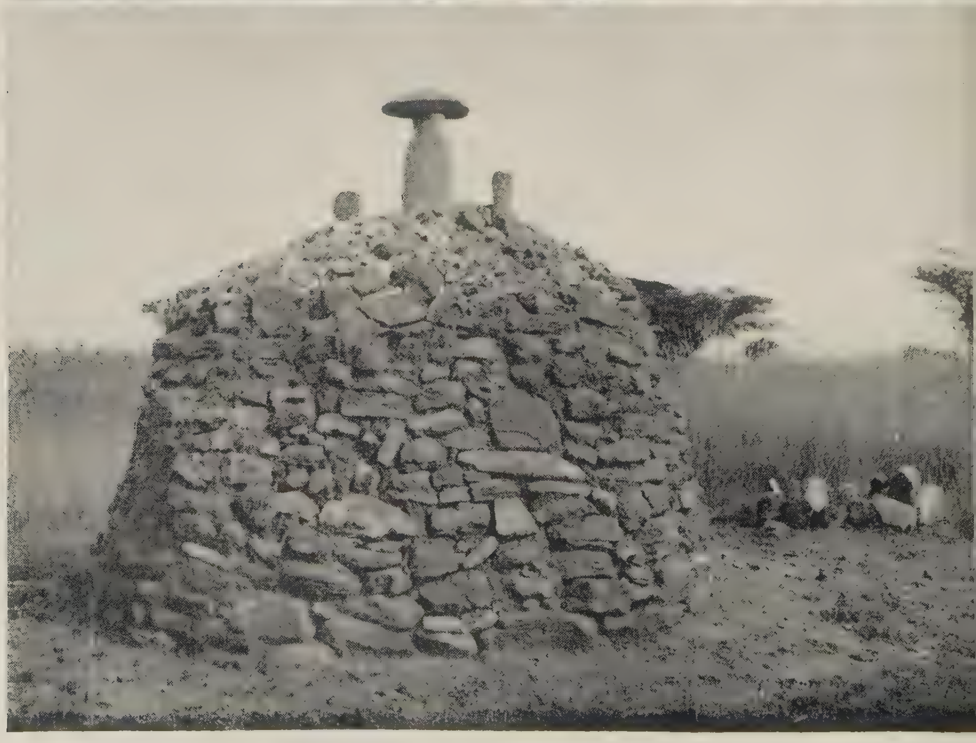


Standing monolith at Watadera (Sidāmo); on left, a fallen column freshly broken to make a recent grave.



An Arussi memorial stone and trophies, north of Shashamanna.





Above, Arussi memorial stones, near Shashamanna.
Below, wayside tomb of a chief, with his son's grave behind on the right, east of Bulghita (Shoné).

PROCEEDINGS OF
THE LINNEAN SOCIETY OF LONDON

Session 1950–51

Vol. 163 Part 3

PROCEEDINGS OF THE GENERAL MEETING ON 5 April 1951

Professor F. E. Fritsch, F.R.S., President,
in the Chair.

The Proceedings of the General Meeting held on Thursday, 8 March 1951, having been circulated, were taken as read, and confirmed.

The following were thanked for gifts made to the Library since the last Meeting :—Mr. A. E. Blake, K.L.B., Professor G. D. Hale Carpenter, M.B.E., Dr. G. S. Carter, Señor Guillermo Hernandez de Alba, Mr. A. A. Prestwich, Dr. C. G. G. J. van Steenis, and Professor F. E. Weiss, F.R.S.

The following signed the Obligation in the Roll and Charter Book and was admitted a Fellow :—Dr. Bernice Giduz Schubert.

In accordance with Chap. 10, Sect. 8 of the Bye-Laws, the following Fellows were elected, by show of hands, as Auditors of the Treasurer's Accounts for 1950–51 :—

Representing the Council : Dr. W. E. Swinton,
Dr. George Taylor.
Representing the Fellows : Mr. I. H. Burkill,
Professor F. W. Jane.

The proposed Alterations in the Bye-Laws, as printed in the report of the Meeting held on 22 February 1951, were balloted for and accepted.

Certificates of recommendation for election to Fellowship, in favour of the candidates named in the Minutes of the Meeting of 8 March 1951 were read for the second time, and for the first time in favour of Michael Robin Alexander Chance, B.Sc., Ph.D., Alan Philps Graham, M.A., Prof. James Eric Smith and Miss Eunice Sylvesta Lorraine Jones, M.Sc.

The President read a letter from Dr. Theodor Mortensen, F.M.L.S., thanking the Society for the award of this year's Linnean Gold Medal.

Universitetets Zoologiske Museum,
København.
15 March 1951.

To the Assistant Secretary of the Linnean Society of London.

Dear Sir,

Your letter of 9 March informing me that I have been nominated for the award of the Linnean Medal gave me a great, and most agreeable surprise. That the Council of the Linnean Society has found me worthy of this great and rare honour gives me a very deep pleasure and a feeling of the deepest gratitude. It is a matter of deep regret to me that I shall be unable to attend the meeting on 24 May. I am suffering from a rather severe angina pectoris, which forbids me any more voyages. Fortunately my working capacity is not influenced thereby—if only I stay quietly at home. Otherwise it would have been glorious to see London once more and to attend the meeting of the Linnean Society to receive and personally express my deep gratitude for the great honour to be bestowed upon me.

Yours very sincerely,
TH. MORTENSEN.

The following communications were read and discussed :—

Prof. G. D. HALE CARPENTER, M.B.E. The butterfly genus *Euploea* in the South Pacific, from Papua to Australia and Tahiti: a biogeographical study (Discussed by Dr. Hugh Scott, F.R.S., Dr. G. S. Carter, Dr. C. F. A. Pantin, F.R.S., and Dr. A. J. Cain.; Prof. Hale Carpenter replied.)

Abstract,—

Euploeinae are a subfamily of Danaidae, with well marked characters. The males have elaborate scent-producing and distributing organs, often associated with alterations in the shape of the wing. The pattern is predominantly spotted, and its origin and peculiarities were discussed. The attractive blue gloss on many of the males of continental and Malaysian species has resulted in their being well known to travellers, and brought home as trophies, perhaps because being typically aposematic they are easily caught. They have a very persistent mousey odour.

Euploea is characteristic of the Indo-Australian region, but four isolated species are known from the Ethiopian region on the islands Bourbon, Mauritius and Rodriguez ; they never reached Madagascar. India and New Guinea seem to have been the centres from which dispersal took place : in the N. Pacific they reached Formosa and the Loo-choo islands, Palau and Guam, but not Hawaii. In the south Pacific they reached Northern and Eastern Australia, and all the island groups from Papua east and south as far as Tahiti, but not the Marquesas. The late A. S. Corbet revised the taxomony in 1943, forming eleven 'groups', of which four do not enter our area.

This study was based on detailed examination of 9,100 specimens recorded, and many others were ignored because of inadequate data.

The details of geographical distribution show that the islands in our area can be subdivided into eight major groups, of which some can be subdivided. These were discussed, special attention being paid to Rennell Island. A striking feature of the islands at the south-eastern end of the Solomons was the prevalence of white-bordered forms in apparent mimetic (Müllerian) associations.

Some data appear to support the theory, in connection with 'drifting continents', that New Guinea has intruded between the Moluccas and the Solomons.

Dr. S. M. MANTON, F.R.S. Habits and the evolution of the larger Arthropodan groups. (Discussed by Dr. C. F. A. Pantin, F.R.S., Prof. G. D. Hale Carpenter, M.B.E., Mr. R. B. Freeman, M.B.E., and Dr. A. J. Cain ; Dr. Manton replied.) [To be printed in full in Journal, Zoology No. 284.]

Abstract,—

A study of the locomotory mechanisms of the Arthropoda shows that a differentiation of habits must have taken place in primitive animals living in the same environment. The persistence of such habits over long periods of time

has led to the evolution of morphological features which facilitate the execution of the selected gaits, and this has been a major factor resulting in the differentiation of many of the larger groups.

Some general features which control the number of leg bearing segments possessed by an arthropod were considered. An increase in leg length is advantageous for speed, but also introduces mechanical difficulties. The latter are eliminated by a reduction in leg number, and the hexapodous condition has been evolved independently many times.

PROCEEDINGS OF THE GENERAL MEETING ON 26 April 1951

Lieut.-Col. R. B. Seymour Sewell, C.I.E., F.R.S., F.L.S.,
in the Chair.

The Proceedings of the General Meeting held on Thursday, 5 April 1951, having been circulated, were taken as read, and confirmed.

The following were thanked for gifts made to the Library since the last Meeting :—Mr. H. H. Bloomer, Mr. M. R. Henderson, Miss Elisabeth Inglis-Jones, Mr. Richard Morse, and Mr. S. Gordon Smith.

The following signed the Obligation in the Roll and Charter Book and was admitted a Fellow :—Dr. Kenneth Noel Grant MacLeay.

The Chairman reported the deaths of Christopher Albert Walter Sandeman, Fellow, and Thomas William Burton, Associate *honoris causa.*

The following candidates for Fellowship were balloted for and elected :—Sidney Fay Blake, A.M., Ph.D., Alexis Bogdan, John Leonard Cloudsley-Thompson, M.A., Ph.D., Joseph George Cockburn, M.Sc., Ph.D., Miss Winifred Mary Curtis, M.Sc., Ph.D., Miss Sylvia Mavis Dixon, B.Sc., Jan Bevington Gillett, M.A., Christopher Leighton Hare, M.Sc., Ph.D., Stanley John Hughes, M.Sc., Ronald William John Keay, M.A., B.Sc., Leonard Nixon Kidd, Edmund James King, M.A., Norman Robert Lee, B.Sc., Rev. Professor R. Lepour, S.J., Ph.L., L.D., Miss Winifred May Page, M.Sc., Ph.D., Reginald Arthur Peachey, Anthony Brian Lowsley Peake, M.A., M.R.C.S. (Eng.), L.R.C.P. (Lond.), Miss Frances Pitt, Peter Bernard Platts, Frederick John Reed, Robert Ross, M.A., Gilbert Westacott Reynolds, Robert Joseph Gay Savage, B.Sc., George Herbert Sewell, G. S. Verma, M.Sc., Ph.D., John Thornton Wildash, Mohammed Badi uz-Zaman Zaman, M.Sc.

A certificate of recommendation for election to Fellowship was read for the first time, in favour of Miss Lilian Haywood Eaton, B.Sc.

Certificates of recommendation for election as Foreign Members were read for the first time, in favour of Professor Bertil Hanström, Ph.D., of the Zoological Institute, Lund, Sweden, and Professor Lorenzo Raimundo Parodi, of the University of Buenos Aires.

The following communications were read and discussed :—

Mr. W. E. Hollows. Exhibit of tropical seeds, mostly Leguminosae, washed up on the shores of Devon and Cornwall. (Discussed by Mrs. Vera Higgins ; Mr. Hollows replied.)

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Dr. E. Trewavas and Dr. W. E. Frost opened a Discussion on Breeding Habits as a factor isolating populations of Fishes. (Discussed by Mr. Burd and Dr. G. S. Carter.)

Abstracts,—

Dr. E. Trewavas : Even before the development of the mathematical theory of differentiation of isolated populations, it was accepted that any form of isolation that included the separation of breeding groups inevitably result in differentiation. The converse was assumed for example in Schmidt's work on the eel problem, one link in which was the following argument :—the characters of the populations of elvers entering all European rivers are shown to be identical ; therefore they must be parts of a single interbreeding population.

Many fishes breed in shoals without pairing. Of these Mayr (1942) postulates that the external stimulus for spawning must be narrowly specific, otherwise "sympatric species might spawn together, thus exposing themselves to the danger of considerable hybridization ".

In a species like the herring, with a wide distribution, it may well be that it has been prevented from splitting into well-defined species because the spawning stimulus is not so narrowly specific. There are shoals of predominantly autumn-spawners and others predominantly of spring-spawners, but it does not appear to be proved that spring-spawners always breed spring-spawners.

Among fishes that pair we may have patterns of breeding behaviour as specific as those of birds. An interesting survey of such behaviour in Cichlidae has recently been published by Dr. and Mrs. Baerends (1950). This deals with the aspects of breeding behaviour that can be studied in aquaria. Related species have been studied in their natural environment by Miss R. H. Lowe, who, in a paper still in the press, has shown how Nyasa species almost indistinguishable in museum samples, show their distinctness in the field especially by their different breeding seasons and places, by different breeding dress of the males and by different duration of the period in which the young shelter in the parental mouth. This last habit involves mutual behaviour of parent and young.

These two techniques, the analysis of behaviour in aquaria and the study of behaviour in the field, are not easily applied to fishes, but if they can be combined they will lead to a much truer understanding of the differentiation of species than that obtained by morphological studies alone. In the Nyasa *Tilapias* the basic differences are ethological and especially connected with breeding and it is here that we must look for the cause of specific divergence, the morphological aspects of which may be only incidental.

Dr. W. E. Frost : Among salmonid fishes there is no proof that specific patterns of breeding behaviour keep related sympatric species apart, but there are several examples, principally among the Salvelinids and Coregonids, of related populations in a single lake that are isolated by the time or place of spawning, or by both. In Windermere the char, which have been considered a single sub-species, *Salvelinus willughbii* (Günther), breed at two distinct times, November–December and in February–March and at two distinct places, the Autumn (Nov.) spawners in shallow water (2 to 3 m.) the Spring (Feb.) in deep water (20 to 30 m.). There appear to be no morphological differences between the fish of the two populations, but the growth-rates are different after the third year. If, as seems possible from the evidence at present avaliable, the time and place of spawning are hereditarily determined in each case, we have the beginning of a differentiation that has not yet expressed itself in morphology.

Similar differentiation in time and place of spawning characterizes the populations of char (*Salvelinus*) and whitefish (*Coregonus*) in certain lakes in Austria, Germany and Sweden. One such pair of sympatric forms is being made the subject of experiments in Sweden (Svärdson 1950). In their parent lake they were distinguished by different spawning seasons, different growth-rates and maximum sizes and different body proportions and numbers of gill-rakers. Samples were transplanted to two lakes hitherto without fish, one form to each lake. Their growth-rates changed, and with them their proportions, but so far as the experiment has gone the breeding times seem to remain as before. If these breeding times continue to remain fixed and hereditary the populations must remain separate and Svärdson suggests that they would have to be regarded as species, however much their proportions might be moulded by the environment acting through the growth-rate. Furthe1 analysis is required, however, especially of the factors which decide the spawning season, whether internal or external. The work of Fabricius (1950) and others on Coregonids indicates that these factors are complex.

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PROCEEDINGS OF THE GENERAL MEETING ON 10 May 1951

Professor F. E. FRITSCH, F.R.S., President,
in the Chair.

The Proceedings of the General Meeting held on Thursday, 26 April 1951, having been circulated, were taken as read, and confirmed.

The following were thanked for gifts made to the Library since the last Meeting:—Mr. J. E. Dandy, Professor F. E. Weiss, F.R.S., and Mr. J. H. G. Peterken.

The following signed the Obligation in the Roll and Charter Book and were admitted Fellows:—Miss Sylvia Mavis Dixon, B.Sc., Mr. Norman Robert Lee, B.Sc., and Dr. Joseph George Cockburn.

Certificates of recommendation for election to Fellowship were read for the second time, in favour of Dr. M. R. A. Chance, B.Sc., Miss Lilian Haywood Eaton, B.Sc., Mr. A. P. Graham, M.A., Miss Eunice Sylvesta Lorraine Jones, M.Sc., and Professor James Eric Smith.

Certificates of recommendation for election as Foreign Members were read for the second time, in favour of Professor Bertil Hanström, Ph.D., and Professor Lorenzo Raimundo Parodi.

The PRESIDENT reported the death of Rear-Admiral Tufton P. H. Beamish, C.B., Fellow of the Society.

The following communications were read and discussed :—

Mr. J. T. Robinson exhibited casts and original specimens of the fossil primate *Paranthropus crassidens* found at Swartkrans, near Krugersdorp, S. Africa, by the late Dr. Robert Broom, F.R.S. A discussion followed, in which the following took part,—Professor S. Zuckerman, C.B., F.R.S., Dr. L. H. Wells, Professor W. E. Le Gros Clark, F.R.S., and Dr. A. Tindell Hopwood.

The following papers were read in title,—

'A new Glycyphagid Mite—*Carpoglyphus munroi*'. By A. M. Hughes, B.Sc., D.I.C., F.L.S. [Printed in *Journ.*, *Zool.*, No. **284**.]

'Studies in the Arabian Orthoptera.—III. New genera, species and subspecies collected by the Anti-Locust Missions'. By B. P. Uvarov, C.M.G., D.Sc., F.R.S., F.L.S. [Printed in *Journ.*, *Zool.*, No. **284**.]

'A contribution to the floral morphology and embryology of *Dendrophthoe falcata* (Linn. f.) Ettingshausen'. By Bahadur Singh. [Printed in *Journ.*, *Bot.*, No. **355**.]

'Embryological studies on *Spiranthes australis* Lindl.'. By P. Maheshwari and S. Narayanaswami. [Printed in *Journ.*, *Bot.*, No. **355**.]

'New and rare British Spiders'. By A. F. Millidge and G. H. Locket.

THE AUSTRALOPITHECINES AND THEIR EVOLUTIONARY SIGNIFICANCE

By J. T. Robinson
(Transvaal Museum).

The Australopithecinae are too well known by now for it to be necessary to give an historical introduction to this discussion. It would, perhaps, be more pertinent to begin with a brief sketch of the geology of the finds.

Fairly extensive exposures of dolomitic limestone, of Precambrian age, occur in the Transvaal and the neighbouring parts of Bechuanaland. During the Palaeozoic and Mesozoic these were overlaid by Karroo sediments which were stripped off during Tertiary times. This erosion was probably completed during the Miocene with the result that further erosion caused fissuration and cavern formation in the dolomite beds. Subsequently a wet phase resulted in the deposition of a thick band of travertine of a high degree of purity in some caverns where conditions were suitable. This was followed by at least one period, possibly several, of drier climatic conditions during which Kalahari-type sand accumulated in caves and fissures which were open to the surface. Animal remains which found their way into these caves were covered up by the sand, thus increasing the chance of preservation. These conditions may have persisted for thousands or even hundreds of thousands of years. As new caverns were continually being opened it is readily apparent that a series of samples of the local fauna would have been preserved. It also follows that the remains in adjacent caves may easily represent faunas separated by ten or a hundred thousand years. This dry period, or periods, was apparently followed by a moister period during which travertine was again deposited. This time it did not form in a thick band but was deposited between the grains of sand and other debris on the cave floor. In this way a hard, well consolidated bone-bearing breccia came into existence. Further erosion has reduced or even entirely removed the roofs of these caves so that many of the deposits occur as weathered patches flush with the present land surface.

So far no accurate geological method has been devised for dating these deposits. The fauna appears to be of Villafranchian type and we may thus provisionally fix the era of the known Australopithecines as falling on or about the Plio-pleistocene junction. This dating assumes the Pleistocene period to have commenced, in round figures, one million years ago, with the Villafranchian representing the time from the beginning of the Pleistocene to the onset of the first glaciation.

Specimens of the Ape-men have been obtained from the following five sites in South Africa, in the order of discovery: Taungs, in Bechuanaland; Sterkfontein and Kromdraai, two miles apart near Krugersdorp and roughly twenty miles west of Johannesburg; Makapansgat, near Potgietersrust in central Transvaal and Swartkrans, a mile from Sterkfontein.

In general external appearance the known Australopithecine skulls resemble those of the great apes having a flat face and small braincase. *Plesianthropus* is fairly prognathous, while *Paranthropus crassidens* has a broad, flat and vertical face unlike that of any known living or fossil pongid. Regarding endocranial capacity we are not on secure ground. The undistorted and virtually complete *Plesianthropus* skull has a capacity of 480 cm^3. The Taungs child, with only the first permanent molar erupted, has half the endocranial cast preserved and a reliable estimate of 500 cm^3. can be made. In a juvenile specimen from Swartkrans, which is of comparable age judged by the stage of eruption of the permanent dentition, the braincase length is 20 to 25 mm. greater than that of the Taungs child and the breadth is proportionately greater. From this and the adult crania in our possession it seems that the general order of brain size of the adult *P. crassidens* is comparable with that of the smaller specimens of *Pithecanthropus*—roughly 800 cm^3.* But it is not clear what significance this might have. If correct it would mean that this form has an endocranial volume appreciably greater than any so far recorded for the great apes but it certainly does not allow us to estimate the intelligence of *P. crassidens*.

The foramen magnum is situated well forward in the base of the skull in a position anterior to that usual in adult pongids. In the latter group the foramen magnum is situated well forward in infants but by the time growth is complete it has adopted a position more posteriad and is directed backward and downward. In Australopithecines this backward migration does not occur; as in the hominids the infant and adult positions are similar. In all cases where the mastoid region is intact, in infant or adult skulls, a small, pyramidal type of mastoid process occurs which has a clearly defined digastric groove associated with it. According to Schultz true hominid mastoid processes do not occur in the Pongidae. The young have no mastoid protuberances but some elderly individuals do have processes which are, however, unlike those typical of hominids.

The nature of the glenoid fossa is of considerable interest. In the Pongidae this is wide and shallow, having no articular eminence but a post-glenoid process occurs which prevents the mandibular condyle from articulating with the tympanic bone. In hominids the fossa is deep and narrow with an articular eminence and a small postglenoid process closely applied to the tympanic bone, which forms the posterior wall of the fossa. Among the Australopithecines, skull V from Sterkfontein has a somewhat pongid type of glenoid fossa while all other known specimens, including two others from Sterkfontein, have the hominid type.

Among the important finds have been three innominate bones belonging to three different genera, as the classification now stands. All show similar characteristics and can easily be distinguished from those of the Pongidae but less easily, though none the less certainly, from those of the Hominidae. In general appearance the australopithecine innominate is of the hominid type with a low but widely expanded iliac blade, a well developed anterior inferior spine and with the acetabulum so situated that an axis passing though its centre is directed at a considerable angle to the iliac blade. There is also a well developed anterior superior iliac spine—which is not a hominid feature. The ischium has the distance between the acetabular rim and the distal area of muscular attachment relatively great ; in which feature it approaches the pongid condition. Except for this point the innominate does not resemble that of the great apes closely. The characters of the australopithecine innominate are those which are associated with a primate habitually employing an erect, bipedal gait. The position of the foramen magnum is in agreement with such a conclusion. The nature of the ischium is perhaps an indication that the bone had not yet been completely adapted to a fully erect gait.

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* Pith. II estimated at 755 c.c. by Von Koenigswald (*in litt.* Le Gros Clark).

Let us now consider some features relating to the dentition. If we reduce the various jaw movements to components in vertical and horizontal planes we see that in the great apes mandibular movements are confined almost entirely to a vertical plane whereas in Hominidae a considerable horizontal component is also present. The restricted movement in pongids is due to the usual presence of canines which are large enough to prevent much lateral jaw movement. In elderly individuals, more especially females, this may not apply. However, this situation results in different types of tooth wear in Pongidae and Hominidae. In the former, canine wear is greater on parts of the sides of the tooth than on the tip, and the post-canine teeth wear more rapidly on the lingual half of the crown in the upper jaw and on the buccal half of the crown in the lower jaw. In hominids the canine wears most rapidly on the tip and the post-canine teeth wear down evenly. *P. crassidens* dentition is better known than that of other known Australopithecines. In this form the canines do not project beyond the rest of the tooth row and all the teeth wear down evenly in the hominid fashion. Incisors and canines are small, markedly resembling those of hominids and could not possibly be confused with those of pongids.

The first lower premolar is an interesting tooth. In the Australopithecines this tooth is, in every known case, a strongly bicuspid tooth with two roots which are entirely fused down one side and incompletely so on the other. In hominids this tooth is always bicuspid, though in many cases the lingual cusp is appreciably smaller than the buccal one. There is usually a single root though traces of incomplete fusion on the mesial face are not uncommon—the so-called Tomes' abnormal root. Occasionally two roots are present. In the pongids this tooth is unicuspid with a low talonid developed from the cingulum. Two roots, unfused, are usual.

The second lower premolar shows a less striking difference in the two groups. In the pongids a pair of high and closely connected cusps occur ; the talonid region is better developed than it is in the first lower premolar and lies at a lower level than the anterior cusps. In man and the Australopithecines the anterior pair of cusps are not so closely connected and lie on the same level as the talonid.

Regarding the upper premolars it is worth noting that in the pongids three roots are usual, in the Australopithecines two roots occur and in hominids usually either two or one, though occasionally three are present.

In pongids the first lower molar almost invariably has five cusps and where an additional cusp occurs it normally is situated between the metaconid and entoconid. It seems that a true tuberculum sextum either never occurs or is excessively rare. Gregory and Hellman have stated that this cusp is unknown in fossil and recent pongids. Hominids, on the other hand, do have this cusp in a small proportion of individuals. In *Paranthropus crassidens* ten teeth are sufficiently unworn to show the cusps and in nine a tuberculum sextum is present. In the tenth a rudiment is present but is perhaps too small to be considered a true cusp. Most of the relatively few first lower molars of the other species of Australopithecines also have this cusp. This seems to be a significant feature ; perhaps the Australopithecines have been the source from which hominids have inherited this cusp.

Schultz has shown that in the eruption of the pongid permanent dentition the second molar erupts before the majority of the milk teeth are replaced—usually only the deciduous incisors have been replaced at this stage. In hominids the sequence is different ; the entire deciduous dentition being shed before the second molar becomes functional. Usually the first permanent molar erupts before the central permanent incisor but occasionally the latter erupts first. This has never been observed in any pongid where the permanent first molar is the first permanent tooth to appear. In *Paranthropus crassidens* one mandible shows the central incisors erupting before the first molars, another shows the reverse order, and an upper and a lower jaw show that the last deciduous tooth is shed at about the time the second molar becomes functional.

Not only is the time of the shedding of the deciduous dentition important but also the morphology of the individual teeth which differ considerably in the pongids and the hominids. The most obvious of the differences is the nature of the first lower molar. In pongids this tooth is semi-sectorial with a single, sometimes partially divided, central cusp and a low talonid with undifferentiated margin—that is, no true cusps occur on the talonid. In both hominids and the Australopithecines the tooth is relatively large and highly molarized, possessing the usual five cusps.

Before proceeding to an attempted assessment of the significance of the facts set forth above I wish to draw attention to a small group of specimens which were recovered from the same breccia mass that yielded the specimens of *P. crassidens*. These consist of a mandible, an isolated first lower premolar, probably from the mandible and the proximal portion of a radius which the late Dr. Broom and I attributed to a new type of early hominid, *Telanthropus*. These occurred in an area of darker breccia on the edge of the main mass, which fact suggested caution in assuming them to be of the same age as the *P. crassidens* material. With the help of Dr. K. P. Oakley and the Department of the Government Chemist in London, analysis of the fluorine content of *Telanthropus* and *P. crassidens* specimens has failed to demonstrate any difference in age.

It has been suggested that *Telanthropus* is, in fact, only an aberrant specimen of *P. crassidens*. For reasons which have been set forth more fully elsewhere and can only be touched upon here, such an explanation seems most unlikely. The general morphology and size of the body and ascending ramus of the mandible, the teeth and radius, point clearly to the fact that *Telanthropus* is a different creature. The teeth are considerably smaller than those of *P. crassidens* but agree well with those of early hominids. In the case of the first molar elementary statistical analysis shows that the difference in size between the *Telanthropus* specimen and the mean for 14 *P. crassidens* teeth is very highly significant.

In attempting the difficult task of assigning the Australopithecines to their correct evolutionary category it is inevitable that one's interpretation of primate evolution will influence the decision made. Any such interpretation must be largely concerned with teeth as they are often all we know of fossil forms.

The pongids are fairly well represented, by teeth at least, from the Oligocene to the present and one cannot fail to observe certain specializations that occur in all known fossil and living pongids. Some of these have already been mentioned, e.g. the semisectorial first lower premolar and robust canines. From *Propliopithecus* onward, these specializations have become more firmly established along with a tendency to elaboration of bony material in the skull ; the production of heavy supra-orbital tori, crests, heavy muzzles and related features. From the little evidence available, a concomitant specialization in limb structure has occurred. The modern pongids are highly specialized animals, the results of the type of specializing evolution which de Beer has called gerontomorphic and which results in a very low evolutionary potential.

Available material relating to hominid evolution does not go back nearly so far, but if we bear in mind the specializations referred to which so uniformly characterize the pongids some highly suggestive facts emerge. From this point of view *Proconsul* is already established in the pongid evolutionary stream ; so also is *Propliopithecus*. Where these pongid specializations have become established we must assume the hominid and pongid evolutionary streams to be already separate. Hominids are relatively generalized and show paedomorphic or neotenic tendencies, i.e. the retention of infantile characters in later and later phases of ontogeny as phylogenesis progresses. Such a trend tends to maintain a high evolutionary potential. Hominids share a surprising number of characters with old world monkeys which are not possessed by pongids. It is generally believed at present that a late Eocene or early Oligocene radiation resulted in three streams : platyrhine, catarrhine and anthropoid—the last group later giving rise to the hominid stream. However the considerations here dealt with suggest as more likely that at least *four* separate streams emerged from the welter of Eocene prosimians and, by the upper Oligocene, where pongids are identifiable, that the hominid stream was already separate.

In such a scheme there can be no doubt where the Australopithecines are to be placed—they belong in the hominid stream. The characters marking the pongid stream exclude them and they clearly have much in common with the hominids.

The australopithecine relationships within the hominid stream are less easy to determine. It seems improbable that those known at present could be human ancestors. However it is not unlikely that the known forms represent survivals of a once widely spread and vigorously evolving australopithecine family in Miocene and Pliocene times. If and when a prehuman ancestor of man is found it will doubtless fit most easily into this family. *Telanthropus* seems to represent at least one case where a proto-hominid Australopithecine crossed the rubicon and became a hominid. It is possible that this event happened more than once and in different places : we have no means of knowing at present, but patient and painstaking exploration in the rich deposits of Africa and the East may well throw floods of light upon this fascinating problem.

Discussion,—

Professor S. ZUCKERMAN : In contributing to this discussion, and in commenting on Mr. Robinson's observations, I shall try to differentiate as far as possible between questions of fact and matters of interpretation. In the first instance it is useful to emphasize that in general appearance and proportions the specimens of *Paranthropus* before us are not human but overwhelmingly simian. The more this fact is overlooked when stressing ' detailed ' features which may differ from the corresponding ones in existing apes, the more likely we are to go astray in our assessment of the fossils. When considering differences, the question that needs to be asked is whether they are more marked than those that occur between existing and fossil types of great ape, and if so, how much more significant they are from the point of view of human phylogeny.

My own observations do not agree with those of Mr. Robinson about certain features of the simian skull. For example, he claims that a mastoid process of the type found in some australopithecine skulls is a hominid character, and he implies that a mastoid process is an exceptional occurrence in the African great apes. In point of fact, a freely-projecting mastoid process is more the rule than the exception in these animals, while the process as it occurs in the *Paranthropus* specimens can readily be matched both in the gorilla and chimpanzee, and differs from the type usually found in Man. Mr. Robinson also suggests that the canines of the great apes cannot be worn down from the tip, and he claims that in these animals the movements of mastication are practically restricted to the vertical plane, there being little or no horizontal component. Again, my observations do not accord with this view. While wear occurs on the antero- and postero-medial aspects, it also occurs from the tip of the canines, which can eventually become so worn that their upper flat surfaces are in line with the incisors. Whether this is due to lateral movements of the jaws in mastication I do not know, but such movement does take place. My own studies also fail to bear out Mr. Robinson's statements about the order of eruption of the teeth in the Great Apes. In my experience, which was corroborated by Schultz, the permanent incisors as a rule erupt before the second molars.

One of the more important points made by Mr. Robinson concerns the forward position of the foramen magnum in the australopithecine skull, and its presumed failure to ' migrate ' backwards during growth, as in the Great Apes. Professor Le Gros Clark has also drawn attention to this feature and has expressed it in terms of a ' condylar position index '. When ' taken in combination ', the value of this index in the skull of *Plesianthropus* 5, that of a ' nuchal area height index ' (which gives a measure of ' the relative height to which the nuchal area extends up on the back of the skull '), and of a ' supra-orbital height index ' (which Professor Le Gros Clark uses to define ' the position of the brain-case relative to the upper part of the face '), ' appear definitely to place the australopithecine skull outside the limits of variation of the large anthropoid apes and to indicate a rather remarkable approximation to the hominid skull '.

Mr. Ashton and I have studied these indices in a wide variety and large number of Primate skulls, and can confirm Professor Le Gros Clark's finding that the values of the supra-orbital height and nuchal-area height indices of *Plesianthropus* 5 correspond to the human figures. On the other hand, we find that the ' condylar position ' index in this fossil skull does not diverge in a statistically significant manner from that of the gorilla, and that it differs from Man and the other Primates which we studied. Professor Le Gros Clark relates the three indices to a common factor—the poise of the head in relation to the vertebral column. Our own observations do not suggest that the three indices are correlated in the way implied by Professor Le Gros Clark, and in so far as the condylar position index is a measure of the balance of the entire skull on the occipital condyles in relation to the vertebral column, they also suggest that if *Plesianthropus* 5 walked upright, its skull was not balanced like the human skull.

The fact that two of the *Paranthropus* specimens demonstrated by Mr. Robinson have pronounced sagittal crests bears on this conclusion. During the course of eruption of the permanent teeth in the living great apes, and the concomitant growth of the jaws, the temporal muscles extend upwards and backwards over the cranial vault to meet the upwardly-extending nuchal musculature (a process that is related to the relatively greater weight of the anterior part of the skull), and in this way the nuchal (occipital) crest is formed. As a general rule, the nuchal crest appears before the upwardly-extending temporal lines meet in the mid-line to form a sagittal crest. At the same time, and presumably because the face grows relatively more than the back of the skull, the position of the occipital condyles ' migrates ' backwards.

I have examined many mammalian skulls, including ape and monkey, without encountering any specimen in which a sagittal crest is not associated with a nuchal crest. Mr. R. Savage has examined the question systematically, and has studied all the primate skulls in the British Museum ; he has also made a careful examination of Insectivora, Cheiroptera and Dermoptera, as well as a survey of Carnivora and Marsupialia. He, too, finds that the development of a sagittal crest is almost invariably associated with a nuchal crest. The sagittal crest usually begins to form posteriorly where the temporal lines come together in the region of the inion. Occasionally, e.g. Cheiroptera, fusion of the temporal lines begins anteriorly. If one of the two crests is missing, it is almost invariably the sagittal crest that is lacking. The only two cases in which Mr. Savage has observed a well-developed sagittal crest and a poorly-developed nuchal crest are (i) a specimen of *Nycticebus* and (ii) some skulls of *Nycterus*, the hollow-faced bat. Neither I nor Mr. Savage have ever observed this condition in a monkey or ape. Moreover, it should be observed that nuchal ridges are not uncommon in primitive human skulls, whereas a sagittal crest of the kind seen in *Paranthropus* and the gorilla is unknown.

Paranthropus crassidens obviously possessed a powerful jaw musculature. This is indicated not only by its powerful jaws but also by the presence of a sagittal crest, and by the depth of the temporal and infra-temporal fossae. Unfortunately, neither of the skulls before us is complete, and the nuchal area is lacking in both. But unless *Paranthropus* provides a single exception to what seems to be a general feature of the architectural dynamics of the Primate skull, our observations about the co-existence of sagittal and nuchal crests in Primates seem to indicate clearly that *Paranthropus crassidens* had a strong nuchal musculature of the kind seen in extant great apes, and that it would have had nuchal crests. As its skull was moulded during growth, the occipital condyles would almost certainly have ' migrated ' backwards, as they do in existing great apes, and as the ' condylar position ' index of *Plesianthropus* in fact indicates.

My own view is, therefore, that the evidence before us implies that *Paranthropus crassidens* held its head in the way one of the living great apes does, and not in the way we do—whatever views the form of the innominate bones before us may suggest about the orientation of its inferior extremities relative to its vertebral column.

It may be necessary to point out that most of the specimens of the Australopithecinae that have been described so far do not possess a sagittal crest. The living great apes are no different. Crests do not occur in young animals. The adult male gorilla almost always has a sagittal crest, but this is most unusual in the female, which usually possesses only a nuchal crest or ridge. The same applies to the orang-outang. A sagittal crest is a very rare phenomenon in the chimpanzee, and to the best of my knowledge it never occurs in the female.

This brings me to the question of interpretation. Mr. Robinson suggests that the position we take about the phyletic significance of the Australopithecinae is necessarily dependent on the general view one has about primate and human evolution. This seems to me to open the way to preconceived conclusions. My view is that one can only interpret the fossils in the light of the morphological facts themselves—and these are by no means as yet clear. Once the facts have been agreed, the next step is to assess the degree of resemblance of the fossils to the great apes, living and extinct, on the one hand, and to man, living and extinct, on the other. In certain features of the skull of *Paranthropus* (for example, the reduction of the canines and the concomitant alteration in the lower first premolar) we are dealing with what seems to be a significant difference between the fossils and living apes. The question we have to ask is whether this difference, and any like ones that may be defined, sufficiently counterbalance the overwhelmingly simian nature of most features of the skull to justify the classification of the Australopithecinae in the Hominidae as opposed to the Pongidae.

In conclusion I wish to thank Mr. Robinson most cordially for the opportunity of examining his specimens. While disagreeing on certain questions, I am at one with him in the desire to see the Australopithecine fossils properly assessed. They add a great deal to our knowledge of the fossil history of the Primates, and we are all deeply in debt to Mr. Robinson's chief, the late Dr. Broom, for having done so much to bring them to light. We can all hope that good fortune will continue to attend the explorations for which Mr. Robinson is now responsible.

Professor W. E. LE GROS CLARK said : there is a general concensus of opinion that the hominid sequence of evolution diverged from the anthropoid ape (or pongid) sequence as far back as Miocene times (and perhaps even earlier). But the palaeontological evidence at present available indicates that the expansion of the brain and the reduction in the size of the jaws and teeth characteristic of *Homo* did not become manifest till the beginning of the Pleistocene. Consequently there must have been a very long period in the evolution of the hominid sequence (i.e. the Hominidae) during which the brain-case, jaws and teeth retained proportions similar to those still shown by the anthropoid apes to-day. It is of the utmost importance to recognize this in discussing the relationships of the Australopithecinae. It has been suggested that the latter are representatives of what may be termed the ‘ pre-human phase ’ of hominid evolution (perhaps late survivors of a collateral branch that persisted in South Africa) ; if this is so, the obviously simian proportions of the brain-case, jaws and teeth are not immediately relevant to the discussion. These simian proportions have, of course, always been recognized by Dart and Broom and others. But the interesting point is that they are combined with morphological features hitherto only recorded in the Hominidae and not found in any of the Pongidae, recent or extinct. Such hominid features are now generally recognized. They include the pattern of the dental arcade, the spatulate form, relative size and mode of wear of the canines, the consistent absence of a diastema, the consistently non-sectorial bicuspid character of the first lower premolar, numerous details of the milk dentition (confirmed by a detailed statistical analysis), and the sequence of eruption of the permanent teeth. All these constitute a total morphological pattern consistently found in the Australopithecinae (of which many specimens are now available) and not demonstrated to occur in any group of anthropoid apes. The skull (in spite of its general ape-like proportions) deviates from all the anthropoid apes in the *combination* of the condylar position index with the supra-orbital height index and nuchal area height index, the consistently forward position of the condyles in relation to the auditory aperture, the details of the construction of the mandibular fossa and auditory region, the relative height of the temporal squama, the contour of the palate, the remarkably small area for the nuchal musculature (even in the Makapan occiput which showed that the temporal ridges must practically have reached the mid-line of the skull further forwards —with perhaps the formation of a median crest) and so forth. The limb-bones and the pelvis (of which there are now three specimens) demonstrate a similar combination of hominid and primitive characters. The pelvis, in particular, confirms the inferences which have been made on the basis of other parts of the skeleton regarding an upright posture approximating to that characteristic of man. The existence of hominid characters in the Australopithecinae is no longer in doubt. The difficulty arises in their interpretation. But they are, morphologically, clearly in conformity with the suggestion that these fossil creatures may be representative of the pre-human phase of the evolutionary sequence of the Hominidae. It does not necessarily follow, of course, that they were *directly* ancestral to *Homo sapiens*, or even to primitive forms such as *Pithecanthropus* (though this may have been the case). They may represent a collateral branch of the hominid sequence, derived from an earlier ancestral group which gave rise to modern man. In any case, so far as the facts are at present available, the interpretation which seems best to fit these facts is that taxonomically they are to be assigned to the Hominidae rather than the Pongidae. Attention is called to the great care which needs to be exercised in the application of statistical methods to the study of these fossil forms, and particularly to the danger of drawing far-reaching conclusions from too limited statistical data.

Dr. A. TINDELL HOPWOOD, in winding up the discussion, suggested that the Australopithecinae might be placed in a 'suspense account' until more was known about their anatomy. In the meantime it would be advisable to forget the controversial aspects and to treat the fossils in exactly the same way as one would treat any other mammalian remains. If that were done, there could be no doubt that the specimens on the table were far too highly specialized to represent possible human ancestors; one need only mention the possession of a sagittal crest on the brain-case, the much enlarged teeth, and the very marked pachyostosis of the mandibular ramus.

The mandibular ramus was almost identical with a fragment found in Java by Prof. von Koenigswald. It suggested that the australopithecines might have been an Asiatic element in the African fauna—there is abundant evidence of faunal interchange at the appropriate times; alternatively, the specimen found in Java might represent an African element in the Asiatic fauna. If he favoured the former hypothesis rather than the latter, it was because the megacerotine deer, the only other terrestrial mammals with a corresponding degree of pachyostosis of the corpus mandibulae appear to be of Asiatic origin.

PROCEEDINGS OF THE ANNIVERSARY MEETING

24 May 1951

Professor F. E. FRITSCH, F.R.S., President,
in the Chair.

The Proceedings of the General Meeting held on Thursday, 10 May 1951, having been circulated, were taken as read, and confirmed.

The PRESIDENT welcomed the presence at the Meeting of His Excellency Herr Gunnar Hägglöf, Swedish Ambassador, and Count E. Knuth, Counsellor at the Danish Embassy.

The PRESIDENT stated that HIS MAJESTY KING GUSTAF VI ADOLF OF SWEDEN had expressed his wish to become an Honorary Member of The Linnean Society of London.

The Linnean Society of London
Burlington House,
Piccadilly,
London, W.1.
2/4/51.

Your Excellency,

The Council of The Linnean Society of London are desirous of proposing the election of H.M. the King of Sweden and of the Goths and Wends as an Honorary Member in succession to their late Majesties Oscar II and Gustav V at our Anniversary Meeting on May 24th next, the day appointed by our Bye-Laws for such election, May I, therefore, ask your Excellency to be so good as to ascertain whether His Majesty would be willing to accept this token of respectful regard and to extend to the Society that honour which we were privileged to enjoy from his Royal Predecessors.

I have the honour to be,
Your Excellency's most obedient Servant,
F. E. FRITSCH,
President.

His Excellency,
H:r Gunnar Hägglöf,
Royal Swedish Embassy,
29, Portland Place,
London, W.1.

Swedish Embassy in London,
29, Portland Place, W.1.
30th April, 1951.

Sir,

Acting upon instructions received I beg to inform you, with reference to your letter of April 3rd, that His Majesty King Gustaf VI Adolf has graciously consented to accept the Honorary Membership of the Linnean Society of London.

I have the honour to be,
Sir,
Your obedient Servant,
S. UNGER,
Chargé d'Affaires a.i.

F. E. Fritsch, Esq., F.R.S.,
President,
The Linnean Society of London,
Burlington, House,
Piccadilly, W.1.

His Majesty was formally elected with acclamation, all present rising in their places.

His Excellency The Swedish Ambassador then conveyed to the Fellows His Majesty's warm appreciation and pleasure at becoming an Honorary Member of the Society, and His Majesty's regret at not being present at the Meeting.

" Mr. President,

His Majesty King Gustaf Adolf has instructed me to express his warm appreciation and thanks for having been called to become an Honorary Member of this most illustrious and ancient Society. His Majesty has asked me to explain to you how much he regrets not being able to attend this Meeting in person.

I believe that we Swedes are particularly sensitive to this generous act, which we would like also to consider as an honour bestowed on our country, because we are so well aware of the deep impressions Linnaeus brought home from his visit to England during the early years of his life, impressions which were to make an impact on his whole outlook as a man and a scientist. Nor are we likely to forget that the first body of men to organize themselves for the purpose of studying and carrying on his work were the founders of your Society. This fact is only further

> brought home to us whenever our own scientists come to London for a personal contact with you, be it for the purpose of studying the current problems of Botany or some of your rich material on that strangely fascinating personality that was Linnaeus himself.
>
> I think few people can have a deeper understanding of these conditions than His Majesty himself, who, as you may well know, is not only a most keen and interested gardener but also has devoted part of his rare leisure to the serious study of your science. In concluding may I extend to you, Mr. President, His Majesty's best wishes for the future of this Society, a wish in which I am sure all his subjects would like to have a part."

The following signed the Obligation in the Roll and Charter Book, and were admitted Fellows :—Dr. John Leonard Cloudsley-Thompson, M.A., Dr. Winifred May Page, M.Sc., Mr. Leonard Nixon Kidd, Mr. Edmund James King, M.A., Mr. Robert Ross, M.A., Dr. G. S. Verma, M.Sc., Mr. John Thornton Wildash and Mr. Mohammed Badi uz-Zaman, M.Sc.

Candidates for membership were balloted for and elected :—

Fellowship.—Maurice Robin Alexander Chance, B.Sc., Ph.D., Miss Lilian Haywood Eaton, B.Sc., Alan Philps Graham, M.A., Miss Eunice Sylvesta Lorraine Jones, M.Sc. and Professor James Eric Smith.

Foreign Members.—Professor Dr. Lorenzo Raimundo Parodi and Professor Bertil Hanström, Ph.D.

The Bye-Laws regulating the Election of Council and Officers having been read by the Assistant Secretary, the PRESIDENT declared the Ballot for new Members of Council to be open, and voting began. The PRESIDENT thereafter appointed Mr. H. R. Hewer, Mr. R. H. Jeffers and Mr. R. Ross, as Scrutineers of the Ballot.

The Ballot was closed at the due time, and the result declared to the Meeting.—NEW MEMBERS OF COUNCIL.—Mrs. F. L. Balfour-Browne, Mr. Alan Fisk, Mr. H. R. Hewer, Dr. B. M. Hobby, Professor F. W. Jane and Mr. Patrick M. Synge.

(The retiring Councillors were Professor A. J. E. Cave, Professor G. H. Hale Carpenter, M.B.E., Mrs. Vera Higgins, Mr. E. W. Mason and Dr. W. E. Swinton ; one Member resigned : Dr. W. R. Philipson.)

The PRESIDENT declared the Ballot for Officers to be open and voting began. The Ballot was closed at the due time, and the result declared to the Meeting.—OFFICERS.—*President* : Professor F. E. FRITSCH, F.R.S. ; *Treasurer* : Colonel F. C. STERN, O.B.E., M.C. ; *Zoological Secretary* : Dr. A. TINDELL HOPWOOD ; *Botanical Secretary* : Dr. GEORGE TAYLOR.

In handing the Linnean Gold Medal to Count E. Knuth for transmission to Dr. THEODOR MORTENSEN, F.M.L.S., the PRESIDENT spoke as follows :—

The LINNEAN GOLD MEDAL is awarded to Dr. Ole Theodor Jensen Mortensen. In making this award we honour a distinguished zoologist who was elected a Foreign Member of the Society as long ago as 1929. A frequent visitor to this country, either for purposes of study at the British Museum and the Plymouth Laboratory or to attend meetings of the British Association, many Fellows of the Society will know him personally and will welcome this tribute to his great distinction.

Dr. Mortensen's scientific career started in 1895 with his appointment to a post at the Danish Biological Station, but a year later he joined the staff of the Zoological Museum of Copenhagen where he subsequently became Director of the Department of Invertebrata and was able to devote most of his life to most fruitful researches. It was at the beginning of this century, while dealing with the Echinoids collected by the Danish 'Ingolf' Expedition that Mortensen recognized the highly unsatisfactory state of knowledge relating to this group, and this decided him to make their study his principal life-work. At an early stage in his researches he realized that the microscopic characters of the various appendages, which up to then had been almost ignored, were just as important as those of the test itself, and this led him to put forward an entirely new classification of the Echinoids. Material collected during his own travels to Siam (1900) and the West Indies (1906), as well as the investigation of that collected by the German and Swedish Antarctic Expeditions, proved the soundness of this new classification, but also suggested the desirability of studying further living material and especially the developmental stages of these organisms. This Mortensen accomplished by extensive travels at various times. From 1914 to 1916 he investigated many areas of the Pacific from Japan to Australasia, in 1929 he visited South Africa, Mauritius and St. Helena, and later paid two visits to the Marine Laboratory at Ghardaqa in the Red Sea.

Among the many memoirs in which the results of these investigations are presented, special mention may be made of that on the development of Echinoderms published in 1921, in which it is shown that the larval stages have an important bearing on, and help to confirm Mortensen's earlier views on, the classification of these organisms. The wealth of material obtained in the numerous regions he visited led him in the early twenties to decide to prepare a comprehensive monograph of the world's Echinodermata, including both the living species and the known fossil forms. The first volume of this monumental work, which was financed by the Carlsberg Foundation and dealt with the Cidarids, was published in 1923 and the last, representing the culmination of nearly 30 years' work, is now in the press.

Zoological science is indebted to Mortensen for many other contributions. A number of his papers deal with Ctenophora and include the description of a remarkable sessile member (*Tjalfiella*) which constitutes the type of a new family, the Tjalfiellidae. Among the papers published as a result of Mortensen's sojourn in the Pacific is one on protective adaptation; this deals mainly with marine animals, but also contains an account of 'pseudocephalic butterflies' in which, when the insect is at rest, the posterior ends of the wings simulate the head and tentacles, while the true head is concealed between the wings.

Mortensen was a vigorous advocate for the publication of the valuable series of handbooks on the fauna of Denmark, of which to date 56 volumes have appeared and to which he himself contributed the volume on Echinoderms. Its appearance prompted the late Prof. Stanley Gardiner to invite the author to prepare a similar treatise on the British Echinoderms; this was published in 1927.

After the 1914–18 war Mortensen was one of a number of Scandinavian Biologists who pressed for the establishment of an International Marine Biological Laboratory in the Malay Archipelago. In connection with this, Mortensen in 1932 visited the Kei Islands which he found to be almost unique as a site for such a station, with a very rich fauna and with deep-sea organisms flourishing in relatively shallow water where their study would be comparatively easy. Unfortunately funds have not yet been forthcoming to implement this very desirable scheme, but at the meeting of the Pacific Science Congress in Java in 1929, at Mortensen's instigation, the project was recorded as one of the important objects to be realized when circumstances permit.

It is a matter for very deep regret that Dr. Mortensen cannot be with us to receive the medal in person. A sufferer from *angina pectoris*, travelling, which has been one of the supreme delights of his life, is now impossible. In handing the Medal to Count KNUTH of the Danish Embassy for conveyance to Dr. Mortensen, I express on behalf of the Society our great appreciation of the valuable contributions Dr. Mortensen has made to biological science and the hope that his malady will not prevent his yet obtaining much of interest and enjoyment out of life.

In reply, Count Knuth expressed his profound appreciation of the honour that had been conferred upon his fellow countryman.

LIBRARIAN AND ASSISTANT SECRETARY'S REPORT

List of the Society.

Since the last Anniversary Meeting the Society has lost 36 members. The detailed statement follows :—

17 *Fellows by death* :

Rear-Admiral Tufton Percy Hamilton BEAMISH, C.B.
Frederick James CHITTENDEN, O.B.E.
William Thomas GORDON.
Sir Sidney Frederic HARMER, K.B.E., F.R.S.
Henry John JEFFERY.
William Percy JONES.
Sir Murdoch MCLEOD.
Pierre Elie Félix PERRÉDÈS.
Robert Brooks POPHAM.
Christopher SANDEMAN.
Mrs. Helen Holme SIMMONS.
Field-Marshal Jan Christiaan SMUTS, P.C., O.M., F.R.S.
Mrs. Beatrice STUART.
Harold WALKEN.
William WILLIAMSON.
Ronald WINCKWORTH.
Sydney Renoden WYCHERLEY.

2 *Foreign Members by death* :

Lucien CUÉNOT.
Merritt Lyndon FERNALD.

2 *Associates* honoris causa *by death* :

Thomas William BURTON.
Albert Harry HAMM.

15 *Fellows by Withdrawal* :

Hamilton BLACKISTON.
Ernest St. John BURTON.
Kenneth Thomas St. George CARTWRIGHT.
Douglas DAWSON.
Paulus Edward Pieris DERANIYAGALA.
Cecil Stevenson GARNETT.
Charles Adrian HOPKINS.
Charles Norman Carlyle JAYAWARDENA.
Frank Whitwam JONES.
John MCDONALD.

Alfred Samuel George MARDON.
Thomas Henry PARSONS.
Clifford Charles TOWNSEND.
Brian Seymour VESEY-FITZGERALD.
John WEBSTER.

During the Session 32 Fellows, 2 Foreign Members and 5 Ordinary Associates have been elected. The number of Fellows on the List is 779 with a further 21 Fellows elected but not yet qualified.

The Library.

Between 1 May 1950 and 30 April 1951, 42 books have been purchased, 116 parts of periodical publications and 49 reprints have been presented. During the same period the number of volumes bound was 372 and 256 volumes have been repaired.

The number of volumes borrowed by Fellows and Associates was 1520 and by the National Central Library 739. 674 signatures were recorded in the Library Visitors' Book.

The Linnaean and Smithian Collections.

During the past year the Collections have been consulted frequently, and many botanists visited the Society on their way to the International Botanical Congress held in Stockholm. Further progress has been made with the compilation of the Catalogue of the Smithian Herbarium.

THE PRESIDENT'S REVIEW

During the 163rd session, which is now drawing to its close, the Society has suffered grievous loss through the death of several Fellows of high rank and distinction. In November of last year we heard with deep regret of the decease of His Majesty King Gustaf V of Sweden, who had been an Honorary Fellow of the Society since 1909. We remember with gratitude that on 3 November 1923 the Society was greatly honoured by a personal visit from His Majesty, during which he signed the Roll and Charter Book on the emblazoned page of vellum specially provided. This historic event is commemorated by the framed photograph which shows His Majesty in the act of inscribing his signature and constitutes one of the treasures of the Society.

Another great loss to the Society has ensued through the death of Field-Marshall the Rt. Hon. Jan Christiaan Smuts, O.M., F.R.S., a man who, though playing a leading rôle as a politician and in the military field, yet found time to make important contributions to the knowledge of the African Flora. Among the several other Fellows, whose death has been reported, I would like to pay special tribute to the memory of Sir Sidney Frederic Harmer, F.R.S., President of the Society from 1927 to 1931, whose many notable contributions to zoological science made him a figure of great distinction. The Fellows have already recorded their sense of loss in a special resolution passed at the General Meeting on 26 October last.

The session has again been a fruitful one in the contributions made at our meetings to the advancement of biological science. Four of the General Meetings were Discussion Meetings. One of them, on the ' Taxonomic Treatment of Biological Races ', was arranged in conjunction with the Systematics Association ; another dealt with the breeding habits of fish. While both of these were full of interest, the other two relating to the nature and origin of man afforded the most lively interchange of diverse opinions. On 8 February Dr. J. W. Jones showed a highly interesting film illustrating the spawning behaviour of the Atlantic salmon. At the first meeting of the session Professor McLean Thompson gave us another of his graphic descriptions of cauliflorous plants, and Dr. Manton's account of the locomotory mechanisms of the Arthropoda on 5 April stands out in my memory among the many important zoological papers contributed during this session.

The reception on 7 December was even more widely attended than that held in the previous session, and it is evident that this kind of gathering is much appreciated by the Fellows, both for the opportunity it affords of inspecting a variety of interesting exhibits as well as for its social value, and the possibility it offers of welcoming a number of guests. The film of the Scolt Head Bird Sanctuary, shown and introduced by Mr. John Chear, contributed greatly to the enjoyment of those attending the reception, and I should like to take this opportunity of once more thanking Mr. Chear on behalf of the Society.

The Council have invited Mr. I. H. Burkill to give the next Hooker Lecture, although at his request the Lecture has been postponed to the next session. Professor Harvey was appointed by Council to represent the views of the Society at the Public Enquiry into the proposed use of parts of Braunton Burrows for purposes of military training. I acted as your Delegate at the Eleventh International Congress of Limnology held in Belgium in August of last year, and was also your Representative at the formal opening of the new Laboratory of the Freshwater Biological Association on 23 September 1950.

In order to enable the Society to benefit by the recovery of income tax on annual contributions paid under seven year covenants, certain alterations in the bye-laws became necessary; these were balloted for and approved at the meeting on 5 April. May I express the hope that as many Fellows as possible will endeavour by signing such covenants to help materially to improve the Society's finances, without cost to themselves? Printing costs are continuously rising, and the Treasurer will probably tell you how difficult it will become to meet them without an increase in our resources. Two parts of Vol. 162 of the 'Proceedings', as well as one part each of the Botany and Zoology Journals, have appeared during this session, which has also seen the publication of the Lectures on Taxonomy delivered during the session 1949–50.

The session has been one foreshadowing several impending changes, involving the departure of old friends and the welcoming of new ones. Dr. B. Barnes, who acted as Deputy Treasurer between 1942 and 1944 and has been Botanical Secretary since 1944, has expressed his wish to retire and the Council have, with great regret, accepted his resignation. It is not the first time that I have been associated with Dr. Barnes and, even without experiencing his unstinted help during the two years that I have occupied the Presidential Chair, I should have been able to testify to the meticulous care with which he performs any duties which he agrees to undertake. His services were quite inestimable during the war years when he remained in London and often fulfilled more than his due share of the work of the Society.

Mr. S. Savage is another of those who is giving up his official position at the end of this session. He has long been a familiar figure in the Society's apartments and at its meetings, and he knows, without my saying it, how many of his friends will sorely miss his presence here. Always courteous and ready to give assistance, and with the Society's interests deeply at heart, he has helped in no slight measure towards the easy running of its affairs. During his long period of office as Librarian and Assistant Secretary he has prepared, apart from other contributions, a series of synopses of the manuscripts in the Society's library, and we hope that he will be able to continue with this valuable work, for which he is so well qualified, during the well-earned leisure that lies before him. The Council have made him a Life Fellow of the Society, and we trust that he will occasionally give us the pleasure of seeing him at our meetings.

His post, which will in future be called that of General Secretary, will be taken over by Mr. T. O'Grady who has been Clerk since 1935. The new Clerk is Miss M. P. Holberton, B.E.M.

At the last Anniversary Meeting I was unable to add anything to what my predecessor had said respecting the proposal for the accommodation of the Scientific Societies in a new centre. Since then, however, the position has become more clearly defined, as will be familiar from announcements in the press, and in particular from the excerpt of Sir Robert Robinson's last Presidential Address to the Royal Society which was published in ' Nature ' last December. At the meeting of the Council of the Linnean Society on 12 October last our representatives on the Scientific Societies Accommodation Committee of the Royal Society were able to place before us particulars of the latest proposals. As a result of the discussion that took place on that occasion, the Council passed and forwarded to the Royal Society a resolution reaffirming their reluctance to relinquish their present accommodation, but accepting in principle the proposal that the Learned Societies should be accommodated at another easily accessible site, on the assumption that the Society would be given the accommodation previously specified as essential, and that the independence of the Society and of its Library would be fully preserved.

At the Anniversary Meeting of the Royal Society on 30 November 1950 the President stated that the nature of the negotiations with the Government had not admitted of that consultation of the Fellows of the Society which had been promised, and this of course places the Officers of every other Society concerned in the same predicament with reference to its members. It would certainly have been more in keeping with present-day practices if the general body of the Fellows had had an opportunity of expressing approval of a scheme which affects the future accommodation of the Linnean Society. I do not believe, however, that a negative attitude would, under the circumstances, have been possible. Nor is there any reason whatever to fear that our status as an independent Society will be in any way jeopardized or that we shall fail to secure quarters adequate for many years to come to house the Society's Library and Collections and to provide suitable accommodation for meeting rooms and offices.

It is not yet possible to divulge the position of the site, but I am convinced that it will meet with general approval. It is near the centre and readily accessible from other parts of London. The Treasury has agreed to bear the cost of the new buildings, and it is unlikely that the transfer will involve us in any considerable expense. The Society will have separate quarters and a separate entrance of its own, very much as in Burlington House. The site no doubt affords a great opportunity to the architect and there is every reason to believe that, to use the words of Sir Robert Robinson, ' the Scientific Societies will be housed in a worthy and impressive building, such a one as could look Somerset House in the face '.

There is of course no immediate prospect of implementing the scheme, but, as stated by the Lord President of the Council in the House of Commons on 21 November 1950, a start will be made as soon as resources can be found. In the meantime, however, the Scientific Societies Accommodation Committee are proceeding with plans and other preliminary arrangements, and we can rely on our representative on that Committee, Dr. Tindell Hopwood, to whom the Council have given plenipotentiary powers, to ensure that the needs of the Linnean Society are fully represented. Dr. Hopwood succeeds Dr. Malcolm Smith on the Accommodation Committee, and I should like to take this opportunity of expressing to the latter our gratitude for his manifold assistance in connection with the earlier negotiations.

In conclusion, I should like to express my thanks to all those who have assisted me during the present session in conducting the Society's affairs.

TREASURER'S REPORT

Printed copies of the Accounts for the financial year which ended on 30 April 1951 are before the Fellows. For comparison, the figures for last year are printed in italics on the left-hand side. A statement has been prepared by the Auditors who certify as to detail; the Audit Committee has inspected the books, verified the investments and bank balances and passed the Accounts; the action of the Committee has been confirmed by the Council.

I will briefly go through the accounts and deal with the main items :—

On the Income side the Admission Fees are lower due to fewer Fellows being elected than in the previous year, the Annual Contributions are about the same. The sales of publications are down on last year, but £603 is satisfactory. The Society again received from the Royal Society the sum of £750 from the Parliamentary grant-in-aid for Publications. Whilst we are deeply grateful for this great help to our funds for expenditure on publications, I should like to see our Fellowship come up to 1,000, this would enable us to carry on our publications without help. The Council has decided to place £500 to the Reserve for Publications leaving a balance in the General Account of £670. The cost of publications has increased this year to nearly £1,700. The Reserve for Publications now stands at £2,616 (see Trust and Reserve Funds).

Library Account.

The Account has a balance of £148.

Library Restoration Fund.

This Fund now has a balance of £1,195 out of £3,380 which has been subscribed. The binding and repairs to books has cost about £1,170 and the purchase of foreign works that were missing from our sets in the Library already amounts to £340. Further, £600 has been spent on extra shelving.

The Society has received donations of only £24 this year, and I should like again to appeal to all friends of the Linnean Library to help this Fund in any way they can, by donations or legacies, in order that this historic and valuable Library may be maintained and conserved.

Trust and Reserve Funds.

I have already mentioned the Publications Reserve, and the only other item that requires explanation is the Reserve Fund which was held to pay the balance of the cost of the new Central Heating System. This has now been expended.

Investments.

The main change in the General Account is the addition of £125 2½% Consols and £96 3½% War Loan 1952, which is the investment of the Composition Fees. There is no change in the Library Account. In the Special Accounts £100 New South Wales 3½% 1930/50 was redeemed and the money was re-invested in 3½% War Loan 1952.

Annual Contributions under Covenant.

Since our last Anniversary Meeting we have been in touch with the Income Tax authorities who have informed us that by virtue of its status, the Society is able to reclaim the tax paid by a Fellow on the amount of Annual Contribution paid under covenant, e.g. if a Fellow paying £4 Annual Contribution undertakes to pay the sum annually for seven years, the Society is able to recover £3 9*s.* 1*d.* per annum which has been paid as Income Tax on the gross amount' The Society has sent out a notice and form of covenant to all contributing Fellows not living abroad, and the Council hopes that Fellows will assist the Society by completing this Deed of Covenant. A number of

Fellows pay their Annual Contributions by Banker's Orders, and signing the Covenant will not disturb their present arrangements with their bank.

I wish to report a legacy of £100 left to the Society by Miss E. F. Noel, a Fellow of the Society.

I should like to thank Mr. O'Grady, our Clerk, for the excellent manner in which the accounts have been kept. Mr. O'Grady carries out the detailed work in keeping the accounts, and I am grateful to him for the conscientious way in which this work has been done.

If any Fellow wishes to ask any questions on these accounts, I will do my best to answer them.

TREASURER'S ACCOUNTS FOR THE

(Presented at the Anniversary

Receipts and Payments of the Linnean Society

General

1949–50 £	RECEIPTS	£	s.	d.	1950–51 £	s.	d.
	To Balance at 1 May 1950 :—						
	Current Account at Bank	702	10	10			
	Deposit Account Post Office Savings Bank	....					
	Cash in hand	6	11	5			
	Awaiting Investment	20	0	0			
613					729	2	3
164	,, Admission Fees				96	0	0
	,, Arrears of Annual Contributions	40	0	0			
	,, Annual Contributions for year	2641	1	8			
	Do. in advance	59	14	0			
2737					2740	15	8
27	,, Do. of Associates				19	19	0
281	,, Composition Fees				164	0	0
335	,, Interest on Investments (including Income Tax recovered)				342	9	10
117	,, Do. Post Office Savings Bank Account				119	14	6
	,, Sales of Publications :—						
	Transactions	24	4	0			
	Journals	414	16	2			
	Proceedings &c.	164	1	11			
717					603	2	1
775	,, Grants in aid of Publications : Royal Society	750	0	0			
	Do. Mrs. E. W. Sexton	50	0	0			
					800	0	0
74	,, Miscellaneous Receipts				33	3	4
57	,, Transfer from Reserve for Publications Fund				430	11	1
—	,, Bequest.—Miss E. F. Noel				100	0	0
100	,, ,, *Miss I. M. Hayward*				....		
100	,, ,, *D. J. Scourfield*				....		
9	,, War Damage Account				1	0	0
	,, Transfer from Reserve Fund				431	1	2
£6106					£6610	18	11

Library

£		£	s.	d.
295	To Balance at 1 May 1950	132	0	1
55	,, Interest on Investments (including Income Tax recovered)	85	4	3
10	,, Donation : Imperial Chemical Industries	10	10	0
—	Do. John Innes Horticultural Institution	10	0	0
250	,, Transfer from General Account	300	0	0
1	,, Miscellaneous Receipts	1	4	3
1000	,, Bequest.—R. J. Flintoff	....		
£1611		£538	18	7

Library

£		£	s.	d.
1884	To Balance at 1 May 1950	1712	18	10
54	,, Donations : Fellows and Friends	24	2	0
250	*The Royal Society*	....		
57	*The Trustees, Imperial Botanical Conference 1935.*	....		
£2245		£1737	0	10

Fellows' Postal

£		£	s.	d.
50	To Balance at 1 May 1590	50	6	5

Year ended 30 April 1951

Meeting, 24 May 1951)

from 1 *May* 1950 *to* 30 *April* 1951

Account

1949–50					1950–51		
£	Payments	£	s.	d.	£	s.	d.
196	By Coal, Electric Current, and Gas				176	9	0
49	,, Repairs: Sundry				750	15	0
92	,, Taxes and Insurance				90	2	1
223	,, Miscellaneous Printing and Stationery				276	10	2
270	,, Petty Expenses and Postages				280	17	7
	,, Publications:—						
	Printing	1566	6	9			
	Distribution	20	13	9			
	Illustrations	83	10	7			
1492					1670	11	1
700	,, Transfer to Reserve for Publications Fund				500	0	0
1580	,, Salaries and Wages				1580	4	11
15	,, 'Zoological Record' (Vol. 86) Donation				15	0	0
—	,, Richard Spruce Plaque—Donation				1	1	0
27	,, International Union for Nature Protection—Donation				2	2	0
100	,, Staff Annuities (Annual Premiums)				62	10	0
	,, Purchase of £125 17*s*. 6*d*. 2½ per cent. Consolidated Stock (Compounders' Fees)				90	0	0
368	,, Purchase of £96 1*s*. 11*d*. 3½ per cent. War Loan, 1952 or after (Compounders' Fees)				91	0	0
15	,, Linnean Medal				33	15	0
250	,, Transfer to Library Account				300	0	0
	,, Balance at 30 April 1951:—						
	Current Account at Bank	173	4	6			
	Deposit Account Post Office Savings Bank	481	6	9			
	Cash in hand	12	9	10			
	Amount awaiting Investment	23	0	0			
729					690	1	1
£6106					£6610	18	11

Account

£		£	s.	d.	£	s.	d.
289	By Periodicals				157	14	6
157	,, Binding				152	3	0
32	,, Books				74	12	8
1000	,, *Purchase of £1414 7s. 11d. 2½ per cent. Consolidated Stock (Flintoff Bequest)*				....		
1	,, Miscellaneous				6	2	1
	,, Balance at 30 April 1951:—						
	Current Account	48	6	4			
	Deposit Account Post Office Savings Bank	100	0	0			
132					148	6	4
£1611					£538	18	7

Restoration Fund

£		£	s.	d.	£	s.	d.
3	By Purchase of Foreign Works				344	4	0
529	,, Binding and Repairs to Books				196	12	6
—	,, Miscellaneous					10	3
	,, Balance at 30 April 1951:—						
	Current Account at Bank	24	4	1			
	Deposit Account at Bank	171	10	0			
	Deposit Account Post Office Savings Bank	1000	0	0			
1713					1195	14	1
£2245					£1737	0	10

Account

£		£	s.	d.
50	By Balance at 30 April 1951	50	6	5

Special Accounts
(Trust and Reserve Funds)

Receipts	£	s.	d.	£	s.	d.
To Balance at 1 May 1950 :—						
Westwood Fund	114	13	2			
Trail Award Fund	18	16	8			
Crisp Award Fund	....					
Hooker Lecture Fund	135	6	8			
Goodenough Fund	9	0	8			
Minchin Fellowship Fund	7	10	5			
Carnegie Corporation Grant	419	3	7			
Reserve Fund	431	1	2			
Reserve for Publications Fund	2546	11	11			
Deposit (Dr. A. H. Uggla)	15	0	0			
				3697	4	3
,, Transfer from General Account :—						
Reserve for Publications Fund	....			500	0	0
,, Interest on Investments (including Income Tax recovered) :—						
Westwood Fund	10	17	4			
Trail Award Fund	3	10	10			
Crisp Award Fund	13	19	1			
Hooker Lecture Fund	21	18	0			
Goodenough Fund	8	12	8			
Minchin Fellowship Fund	3	0	0			
Staff Pension Fund	8	12	9			
				70	10	8
,, Trail Award :						
Amount received on redemption of £100 New South Wales 3½ per cent. Stock 1930–50	....			100	0	0
				£4367	14	11

Payments	£	s.	d.	£	s.	d.
By Reserve Fund :—						
Transfer to General Account	....			431	1	2
,, Reserve for Publications Fund :—						
Transfer to General Account	....			430	11	1
,, Staff Pension Fund :—						
Purchase of £8 12*s.* 10*d.* 3 per cent. Savings Bonds 1955–65	....			8	12	9
Trail Award :—						
,, Purchase of £102 3*s.* 11*d.* 3½ per cent. War Loan 1952 or after	....			100	0	0
,, Balance at 30 April 1951 :—						
Westwood Fund	125	10	6			
Trail Award Fund	22	7	6			
Crisp Award Fund	13	19	1			
Hooker Lecture Fund	157	4	8			
Goodenough Fund	17	13	4			
Minchin Fellowship Fund	10	10	5			
Carnegie Corporation Grant	419	3	7			
Reserve for Publications Fund	2616	0	10			
Dr. A. H. Uggla (Deposit)	15	0	0			
				*3397	9	11
				£4367	14	11

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* Including £3328 6*s.* 9*d.* in Post Office Savings Bank.

	£	s.	d.			30 April 1951. £	s.	d.
				General Account				
	1000	0	0	3½ per cent London County Consolidated Stock 1958-68	@100	1000	0	0
	1548	8	9	British Transport 3 per cent. Guaranteed Stock 1978–88	@ 87	1347	2	9
	338	6	8	3½ per cent. War Loan, 1952 or after	@ 90	304	10	0
	1000	0	0	2½ per cent. Defence Bonds	@100	1000	0	0
	2199	18	6	4 per cent. Australian Stock 1961–64	@101	2221	18	6
	200	0	0	3 per cent. War Stock 1955–59	@102¾	205	10	0
	1139	13	0	3 per cent. Savings Bonds 1955–65	@ 99	1128	5	0
	3134	3	9	2½ per cent. Consolidated Stock	@ 66½	2084	4	8
	176	19	3	3 per cent. Savings Bonds 1960–70	@ 94¾	167	13	5
	274	5	5	3 per cent. Treasury Stock	@ 78	213	18	8
	125	17	6	2½ per cent. Consolidated Stock	@ 66½	83	14	0
	96	1	11	3½ per cent. War Loan, 1952 or after	@ 90	86	9	8
						£9843	6	8
	£	s.	d.	*Library Account*		£	s.	d.
	471	18	9	British Transport 3 per cent. Guaranteed Stock 1978/88 (Bentham Bequest)	@ 87	410	11	8
	103	12	5	Surrey County 3 per cent. Stock 1961–66 (Wakehurst Bequest)	@ 96½	99	19	10
	191	12	7	4 per cent. Australian Stock 1961-64 (Walker & Morey Bequests)	@101	193	10	10
	107	2	1	2½ per cent. Consolidated Stock (Stebbing Bequest)	@ 66½	71	4	6
	530	0	0	3 per cent. Savings Bonds 1960-70 (Tagart Bequest)	@ 94¾	502	3	6
	1414	7	11	2½ per cent. Consolidated Stock (Flintoff Bequest)	@ 66½	940	11	5
						£2218	1	9
	£	s.	d.	*Special Accounts*		£	s.	d.
£1063 10 7	232	5	0	Metropolitan Water Board 3 per cent. "B" Stock (Westwood Bequest)	@ 79	183	9	6
	667	14	2	Ditto ditto (Hooker Lecture Fund)	@ 79	527	9	9
	163	11	5	Ditto ditto (Goodenough Fund)	@ 79	129	4	5
	409	11	1	2½ per cent. Consolidated Stock (Crisp Award Fund)	@ 66½	272	7	1
	148	1	0	,, ,, ,, (Crisp Award Fund)	@ 66½	98	9	0
£380 10 6	156	7	2	,, ,, ,, (Westwood Fund)	@ 66½	103	19	6
	74	14	6	,, ,, ,, (Hooker Lecture Fund)	@ 66½	49	13	10
	149	8	10	,, ,, ,, (Goodenough Fund)	@ 66½	99	7	7
	285	19	2	3 per cent. Savings Bonds (Staff Pension Fund)	@ 99	283	1	11
	8	12	10	,, ,, ,, 1955–65 (Staff Pension Fund)	@ 99	8	11	1
	100	0	0	,, ,, ,, 1960–70 (Minchin Fund)	@ 94¾	94	15	0
	102	3	11	3½ per cent. War Loan 1952 or after (Trail Award Fund)	@ 90	91	19	6
				F. C. STERN, *Treasurer.*		£1942	8	2

We have (in conjunction with the Professional Auditors, who certify as to all details) audited the Accounts of the Society for the year ended 30 April 1951 and found them correct. We have verified the Investments and Bank Balances.

17th May 1951.
W. B. KEEN & Co., *Chartered Accountants,*
Finsbury Circus House,
Blomfield Street, London, E.C.2.

A. TINDELL HOPWOOD, W. E. SWINTON,
I. HENRY BURKILL, GEORGE TAYLOR,
FRANK W. JANE,
} *Audit Committee.*

On a motion by Lt.-Col. R. B. SEYMOUR SEWELL, C.I.E., F.R.S., seconded by Mr. E. W. MASON the Report and Statement of Accounts were adopted.

The PRESIDENT then delivered his Address on 'The Evolution of a Differentiated Plant: A study in Cell Differentiation'.

PRESIDENTIAL ADDRESS

By Professor F. E. FRITSCH, F.R.S., P.L.S.

THE EVOLUTION OF A DIFFERENTIATED PLANT: A STUDY IN CELL DIFFERENTIATION.

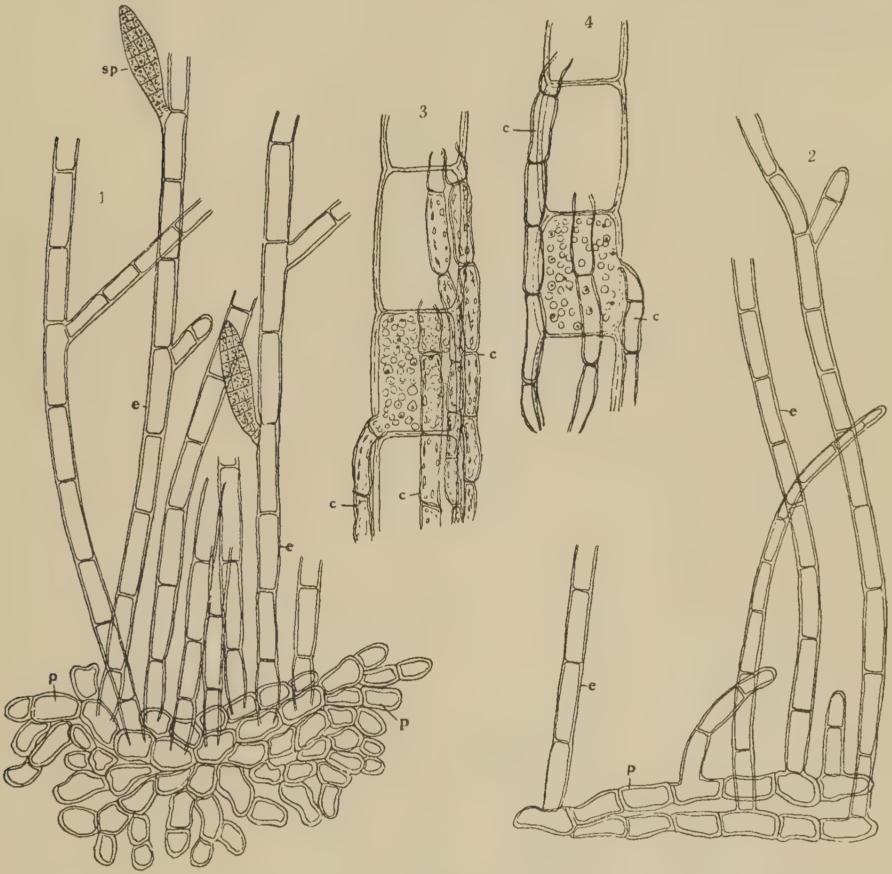
(With Plate 29 and 52 text-figures.)

Among the diverse methods employed in endeavouring to trace the progressive differentiation that followed upon the acquisition of the multicellular habit, that of comparative study of existing plants has perhaps been most productive of positive results and, in the hands of such a master as Bower, has contributed much to our knowledge of the evolutionary history of ferns. Those investigations dealt with plants which have already attained a comparatively elaborate structure; but the comparative method can also provide excellent material for the tracing of early stages in cell differentiation, especially among relatively unspecialized forms. Such comparisons, moreover, help to shed light on the probable evolutionary sequence among these plants.

My object to-day is to deal with one such line of progression among non-vascular plants where it is possible to trace series of increasing complexity, and it is the brown seaweeds that furnish the materials for such a study. Here we find relatively highly differentiated parenchymatous types, as well as an assemblage of much simpler forms that provide us with progressive stages in elaboration. Whether the ancient rocks will ever disclose sufficient recognizable remains of this particular evolutionary series, to prove or disprove the correctness of the arguments I shall put before you, must remain an open question. Until then comparative study constitutes the only method of approach.

No one nowadays probably doubts that the first plants were one-celled organisms, from which, as a result of the failure of the cells to separate after division there arose filaments or other forms of simple multicellular plants displaying little or no differentiation among the cells. There is good reason to believe that, among such simple types of multicellular plants, there appeared at a comparatively early stage the type of structure which I have called a heterotrichous filament (Fritsch, 1929, p. 111), which is met with and often widely represented in all the major classes of the algae (Fritsch, 1939). I have given elsewhere (Fritsch, 1942, 1945) the cogent reasons for regarding this as the starting-point from which many, and perhaps all, of the more complex forms of plants originated and do not propose to dwell further upon these matters here. It must, however, be emphasized that in the majority of the less advanced Phaeophyceae, which are characterized alike by comparative simplicity of vegetative structure and unspecialized methods of reproduction, the life of the individual plant always starts as a heterotrichous filament (Fritsch, 1945 *a*, p. 50).

These brown algae, which I group as Ectocarpales (Fritsch, 1945 *a*, p. 49), include a very wide range of simple seaweeds, among which *Ectocarpus* itself appears as the most primitive. In many of the species the plant is a heterotrichous filament (fig. 1) and remains as such throughout its life. The first part of the alga to arise from the germinating zoospore or zygote, as the case may be, is an often extensively branched thread which creeps over the substratum (figs. 1, 2, *p*). The cells are well supplied with chromatophores, and this first formed prostrate system at this stage carries on all the photosynthesis of the plant. From some or many of its cells there arise sooner or later vertically offstanding branches (figs. 1, 2, *e*), themselves often abundantly branched, and this erect system now takes over the major rôle in photosynthesis and usually also bears the reproductive organs (fig. 1, *sp*). It is unnecessary to dwell further on *Ectocarpus*, except to draw attention to two special features. Some species do not produce a prostrate system, but from the first give rise to an erect-growing axis. This is so in *E. granulosus* which displays its specialization also in the second feature, namely the outgrowth from the lower ends of the older cells of numerous fine threads (figs. 3, 4, *c*) which grow over the lower part of the filament and often form a complete cortical investment around it. Both features are of some significance in relation to what is found in more advanced forms.



FIGS. 1–4.—1, 2, *Ectocarpus* sp. (cf. *confervoides*), young plants; 3, 4, *E. granulosus* (J. E. Smith) C.Ag., older cells, with cortical threads (*c*). *e*, erect and *p*, prostrate systems; *sp*, plurilocular sporangium. (1, 2 ×220; 3, 4 ×200.)

Starting from *Ectocarpus* it is possible to trace a multiplicity of evolutionary series among the Ectocarpales, but I propose to-day to select only a few examples from one of these, namely that in which progressive transverse and longitudinal septation of an erect thread results in a firm parenchymatous structure. *Phloeospora brachiata*, a small and rather rare summer epiphyte differs vegetatively but little from an *Ectocarpus*, in fact Harvey in his

'Phycologia Britannica' (1846, Pl. 4), referred it to that genus. In young plants (*cf.* fig. 5) the filaments often show only transverse septa, except in the cells bearing the commonly paired branches (*br*) which usually undergo some longitudinal septation at an early stage. Gradually more and more longitudinal septa, orientated in different planes (figs. 7, 8), appear in the cells in certain stretches of the threads, but these stretches are commonly separated by lengths in which the cells remain undivided (*cf.* fig. 6) and this is always so in the tips of the various branches (fig. 5, *h*). In places the longitudinal septation results in the formation of a central group surrounded by a layer of narrower cells (figs. 6, 9), but there is little differentiation between the two (Kuckuck, 1929; Mathias, 1935) and the cells of neither series usually divide further. *Phloeospora* is in fact one of the simplest parenchymatous brown algae existing at the present day.

A somewhat similar seaweed is the likewise epiphytic *Stictyosiphon* (Sauvageau, 1929, p. 287; Rosenvinge, 1935) where, however, septation of the embryonic thread is more extensive and soon leads to the differentiation of a surface-layer of cells with chromatophores (figs. 12, 15, *m*), surrounding a few larger ones (*i*) with scanty contents. During subsequent growth the surface cells (fig. 13, *m*) remain small, as they continue to divide by anticlinal walls and occasionally by a periclinal one (figs. 15, 16), while the inner cells undergo no further division. The often considerable surface growth leads, in the particular form I have studied, largely to a widening of the thallus-branches, the plants themselves remaining of small stature and possessing comparatively few branches *. As a result of the surface expansion the inner cells become more and more dilated (figs. 14, 17, *i*), and the contrast between the small peripheral (figs. 13, 14, *m*) and the relatively huge central cells (*i*, shown by the interrupted lines in fig. 13) becomes increasingly marked. In some forms like *Stictyosiphon tortilis* the inner cells may also undergo appreciable lengthening. The occasional periclinal division in the peripheral layer adds further cells to the central group (figs. 15, 17, *su*). Such tangential divisions are few in *Stictyosiphon* and do not seem to go beyond the formation of a single layer (figs. 14, 15, *su*) intervening between the surface one and the central large cells (*i*). In such a seaweed as *Scytosiphon*, however, they may be somewhat more numerous, and here several layers of cells may be found lying within the superficial meristematic layer, the outer later-formed ones being shorter than the more internal ones, as they have not been subjected to so much stretching (*cf.* fig. 18). The rapid growth of *Scytosiphon*, which is accompanied by copious anticlinal division in the surface-layer, leads to the separation of the inner cells so that the older thalli are fistular.

The two examples just considered exemplify tendencies which are more pronounced in the advanced parenchymatous Phaeophyceae, namely (*a*) the retention of a capacity for abundant division by the cells of the outermost layer whereby more or less considerable surface-enlargement is brought about and there are occasional additions to the inner cells, (*b*) the loss of the capacity for division by the inner cells so that they undergo passive elongation and widening by stretching. The cells of the surface-layer constitute the photosynthetic system, while the inner cells probably mainly serve for storage. The peripheral layer also fulfils protective functions, since the outer wall of the cells is often appreciably thickened (*cf.* fig. 27, *m*). It thus serves as a protective, photosynthetic and meristematic layer and may appropriately be

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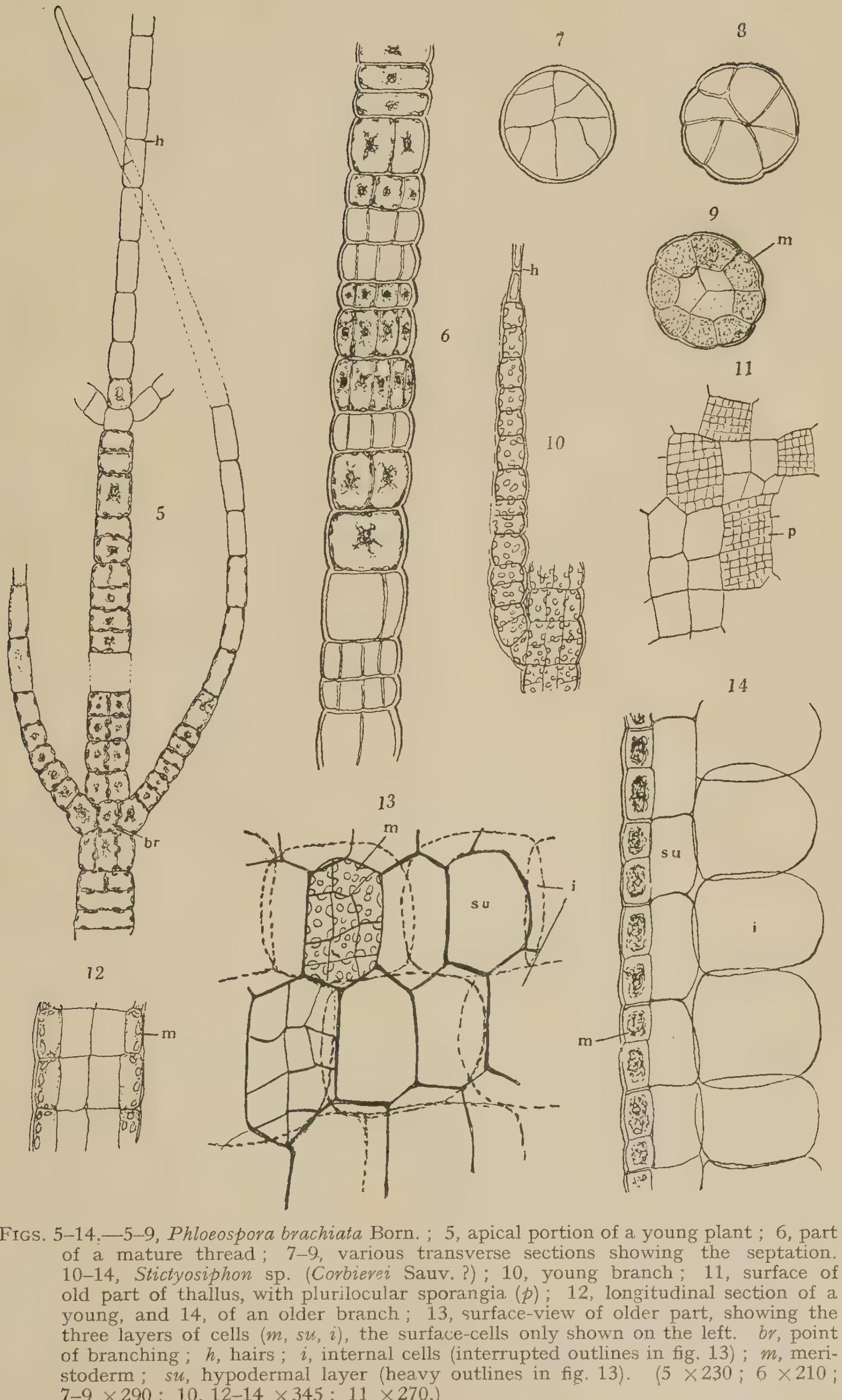
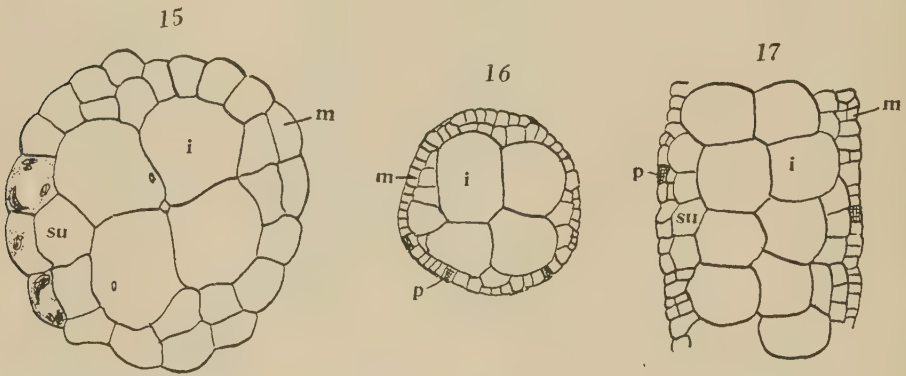
* The material in question occurred among the algal growth on the surface of submarines and other vessels in the Millport region of Scotland. The plants were only a few centimetres in length and not very richly branched, although the older parts bore plentiful plurilocular sporangia (fig. 11, *p*). So far as could be ascertained there was very great resemblance to the *Stictyosiphon Corbierei* described by Sauvageau (1929, p. 298), from whose account figs. 16 and 17 are reproduced.



FIGS. 5–14.—5–9, *Phloeospora brachiata* Born. ; 5, apical portion of a young plant ; 6, part of a mature thread ; 7–9, various transverse sections showing the septation. 10–14, *Stictyosiphon* sp. (*Corbierei* Sauv. ?) ; 10, young branch ; 11, surface of old part of thallus, with plurilocular sporangia (*p*) ; 12, longitudinal section of a young, and 14, of an older branch ; 13, surface-view of older part, showing the three layers of cells (*m*, *su*, *i*), the surface-cells only shown on the left. *br*, point of branching ; *h*, hairs ; *i*, internal cells (interrupted outlines in fig. 13) ; *m*, meristoderm ; *su*, hypodermal layer (heavy outlines in fig. 13). (5 ×230 ; 6 ×210 ; 7–9 ×290 ; 10, 12–14 ×345 ; 11 ×270.)

designated by the term meristoderm which Sauvageau (1918, p. 99) first applied to this layer in Laminariales.

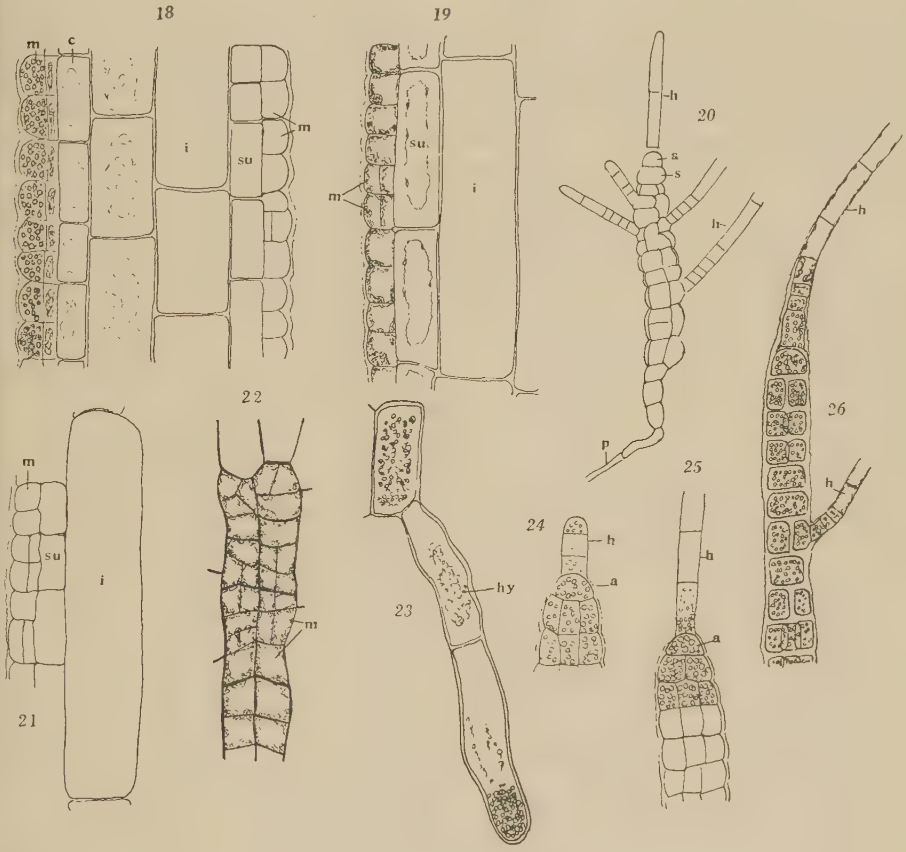
Both in *Stictyosiphon* and *Scytosiphon* the advance on *Phloeospora* is shown, not only by the greater bulk of the thallus and the evidence of differentiation among the cells, but is recognizable also in the primary heterotrichous stage, since the prostrate system takes the form of a comparatively firm and sometimes several-layered, disc, while the erect thread from which the mature thallus develops and which in *Scytosiphon* remains unbranched, undergoes longitudinal septation at an early stage. The short projecting column thus formed, both here and in other parenchymatous Ectocarpales, is commonly capped by a hair (*cf.* fig. 20, *h*) elongating by the division of a basal meristem, whose segments make little or no contribution to the underlying thallus. Whatever be the function of these hairs, which often occur abundantly also in a lateral position on the older parts (figs. 20, 26, *h*), their frequent presence at the summit of the embryo thallus is a striking feature.



FIGS. 15–17.—15, *Stictyosiphon tortilis* Reinke, transverse section of thallus (after Rosenvinge). 16, 17, *S. Corbierei* Sauvageau (after Sauvageau); 16, transverse, and 17, part of an optical longitudinal section of the thallus. *i*, internal cells; *m*, meristoderm; *p*, plurilocular sporangia; *su*, hypodermal layer. (15 ×340; 16, 17 ×155.)

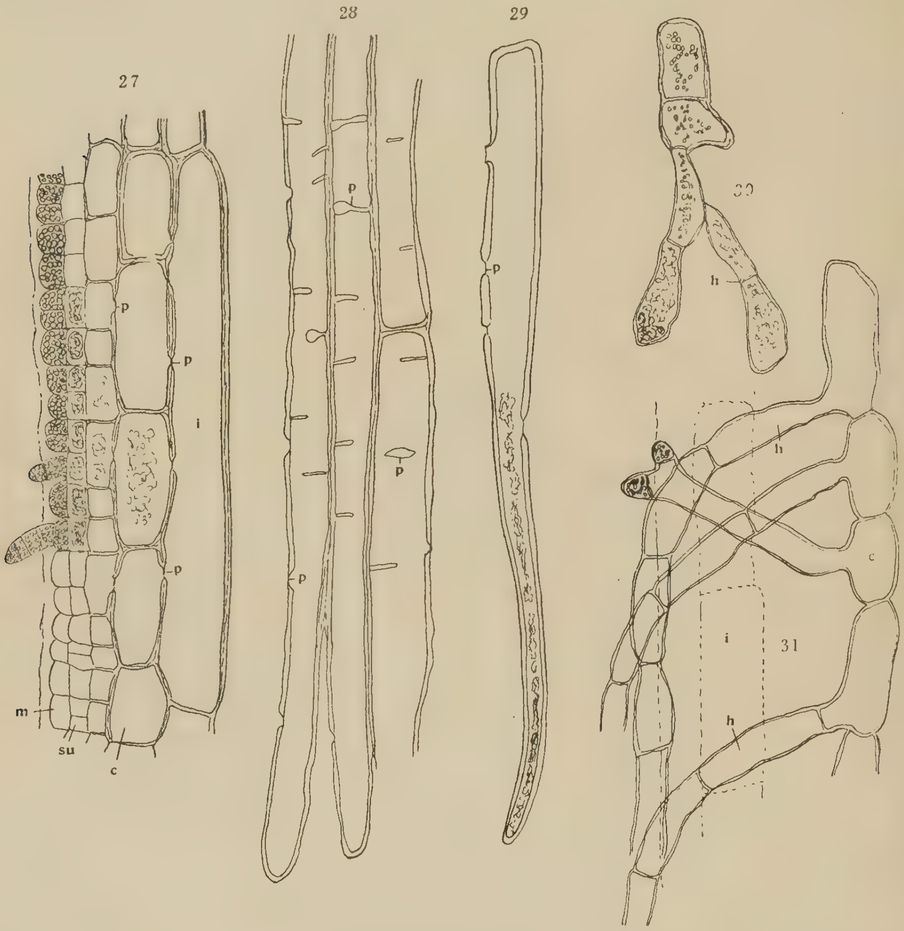
They are met with in this position also in *Dictyosiphon* (Murbeck, 1900), the last of the Ectocarpales to be considered. This genus is one of the most specialized of the parenchymatous Ectocarpales in anatomical structure, as well as in other respects with which I cannot deal to-day. Whilst in the simple brown seaweeds previously discussed growth of the thalli is for the most part diffuse and never strictly localized at any one point along the longitudinal axis, *Dictyosiphon* exhibits apical growth of its many branches, at least during the early part of their life. As Sauvageau (1929, p. 259) has demonstrated, the apical cell appears early on the primary axis of the germling, whilst this is still capped by the hair (fig. 20 *h*). The young branches found on the older thallus (figs. 25, 26, *h*) often show the same feature, although some of these at least may have formed the hair after growth in length had ceased (*cf.* fig. 24). Sooner or later the terminal hair is shed and the dome-shaped apical cell then occupies the summit of the germling or branch, as the case may be. It cuts off parallel to its base a single row of segments (fig. 20, *s*) by whose subsequent enlargement and division the mature thallus is built up, much as in a *Stictyosiphon* (*cf.* figs. 18, 19). In many of the branches the activity of the apical cell is limited, most of the growth in length being due to the copious subdivision of the segments, a process to which the apical cell itself falls prey sooner or later.

Plants of *Dictyosiphon foeniculaceus* may reach a length of half a metre. The superficial cells cut off by the first longitudinal divisions in the segments, as the latter lengthen and widen, divide by repeated walls at right angles to the surface so that these cells constituting the meristoderm (fig. 22, *m*) layer remain small. In the younger parts one can often detect, on inspection from the surface, a transversely banded appearance, since the meristoderm cells formed from a given segment of the apical cell are separated from those derived from adjoining segments by slightly thicker walls. The cells of the meristoderm also divide by frequent tangential septa (fig. 21, *m*) so that several layers of internal cells are formed, as the cylindrical strands progressively widen. The innermost of these cells (figs. 18, 19, *i*) are appreciably elongated, even in comparatively young regions, and in the older parts may attain to a great length (fig. 27, *i*), being sometimes as much as thirty-five times as long as broad. This cannot be due to mere stretching, but must for the most part result from direct growth. These elongate elements have few contents and



FIGS. 18–26.—*Dictyosiphon foeniculaceus* (Huds.) Grev. 18, 19, 21, longitudinal sections of parts of thallus of successive ages, 21 being the oldest; 20, young plant (after Sauvageau); 22, surface-view, showing cells of meristoderm; 23, cortical cell, with hypha (*hy*); 24–26, apical portions of branches, with terminal hairs. *a*, apical cell; *c*, cortex; *h*, hairs; *hy*, hypha; *i*, internal cells (medulla); *m*, meristoderm; *s*, segment of apical cell; *su*, hypodermal layer. (18, 19, 21, 23 ×165; 20 ×300; 22 ×245; 24–26 ×350.)

relatively thick walls provided with slit-shaped pits which are quite irregularly disposed and in part of peculiar shape (fig. 28, *h*). I have seen no transverse septa in these elements, the ends of which are usually bluntly rounded, though sometimes gradually attenuated to a point (fig. 29). The innermost cells are pulled apart and ultimately disorganize in the lower regions of the thallus which become hollow.



FIGS. 27–31.—*Dictyosiphon foeniculaceus* (Huds.) Grev. 27, part of a longitudinal section of an old part of the thallus ; 28, 29, medullary (internal) cells ; 30, 31, hyphae arising from cortical cells. *c*, cortex ; *h*, hyphae ; *i*, internal (medullary) cells (interrupted outlines in fig. 31) ; *m*, meristoderm ; *p*, pits ; *su*, hypodermal layer. (×210.)

Surrounding these, ultimately almost fibre-like, central elements are the successively shorter ones, of more recent origin from the meristoderm, which may be described as cortex and appear typically parenchymatous in shape (figs. 18, 27, *c*). They, too, in the older parts undergo appreciable thickening of their walls which display prominent pits (fig. 27, *p*). As compared with the cells of the meristoderm and of the immediately underlying layer (*su*), those of the cortex usually possess comparatively scanty cytoplasmic contents, although in the lower parts of the axis they are commonly filled with rather plentiful storage substances. It is in these regions that many of the cells of the cortex put out often elongate branching threads (figs 23, *hy* ; 30, 31, *h*) which penetrate downwards among the other elements and play a part in forming the attaching disc at the base of the plant. According to Murbeck (1900, p. 22) similar, but seemingly rather narrower, threads arise in the basal regions of the larger branches and extend into the central hollow of the main axis. These diverse thread-like outgrowths or hyphae, as they are usually called, are no doubt homologous with the corticating threads described previously in *Ectocarpus* (p. 219) and also met with in *Stictyosiphon* (Rosenvinge, 1935, p. 14). Similar structures are widespread in Phaeophyceae and other algal classes, and probably in the main fulfil a mechanical function, although possibly also concerned in conduction.

In the possession of apical growth, in the marked differentiation of the older thallus into meristoderm, a cortex of larger cells and a central region with greatly elongated cells, as well as in the appearance of pits and the production of hyphae in the older parts, *Dictyosiphon* has attained to a level of anatomical organization which in many respects foreshadows that met with in Fucales, the most specialized of the brown algae exhibiting apical growth. The gap between the forms we have been discussing and the Fucales is of course very wide, if the reproductive mechanisms and elaborate external differentiation of many of the latter is taken into consideration. The anatomical structure, however, of those Fucales which are not specialized for life between tide-levels, scarcely displays any intrinsically new features, although everything is on a much larger scale. There can of course be no question whatever of any direct origin of Fucales from present-day Dictyosiphonaceae, but to my thinking it is not improbable that the ancestors of the Fucales passed through a sequence of stages analogous to that I have traced out in representatives of selected Ectocarpales.

The ova of Fucales divide, soon after fertilization, by rather regularly orientated transverse and longitudinal walls to form a globular mass of cells, those adjacent to the substratum soon growing out into attaching rhizoids. As in all advanced algal groups, the heterotrichous condition, typical of the less specialized forms, has disappeared. Before long a contrast becomes apparent between the outer and inner cells (Oltmanns, 1889), the former (figs. 33, 36, *me*) dividing abundantly by walls perpendicular to the surface, whilst the latter (*m*) enlarge without much segmentation. As a result the embryo begins to lengthen (fig. 33). At this stage it is not unlike a young *Scytosiphon* or *Dictyosiphon*, though broader owing to its origin from a voluminous egg. The resemblance is heightened in *Fucus* itself by the appearance of first one and then other apical hairs (fig. 35, *h*) which are apparently lacking in most other Fucales. The outer cells (figs. 33, 36, *me*) also exhibit occasional periclinal divisions whereby additions are made to the inner cells so that by degrees one can distinguish in the lengthening embryo a central medulla of somewhat elongate cells (fig. 33, *m*) around which the meristoderm is progressively building up a cortical region.

Before such differentiation has proceeded very far, however, an apical cell appears at the top of the embryonic column and begins to play its part in building up the tissues of the thallus. It is probably of some significance and, in the present context, an interesting point of comparison with *Dictyosiphon*, that in *Fucus* (Nienburg, 1931) the apical cell (fig. 35, *a*) arises from the cell beneath the first of the afore-mentioned hairs (*h*) which soon wither. The apical cells* of Fucales are more complex than those of *Dictyosiphon* and are nearly always located at the base of a deep pit or furrow (fig. 32, *a*). They are in general large three-sided structures, not unlike the tetrahedral apical cells of many Pteridophyta and of mosses. The resemblance is particularly striking in transverse sections (fig. 34), which display clearly the three-sided character, whilst in longitudinal sections (figs. 32, 37, *a*) the apical cell usually appears more or less biconvex, though rather broader at the outer than at the inner end. The more elaborate form of the apical cell can perhaps be related to the more bulky construction, but the three-sided apical cell is so widespread amongst the less specialized plants that its presence is probably linked with more profound underlying organogenic principles.

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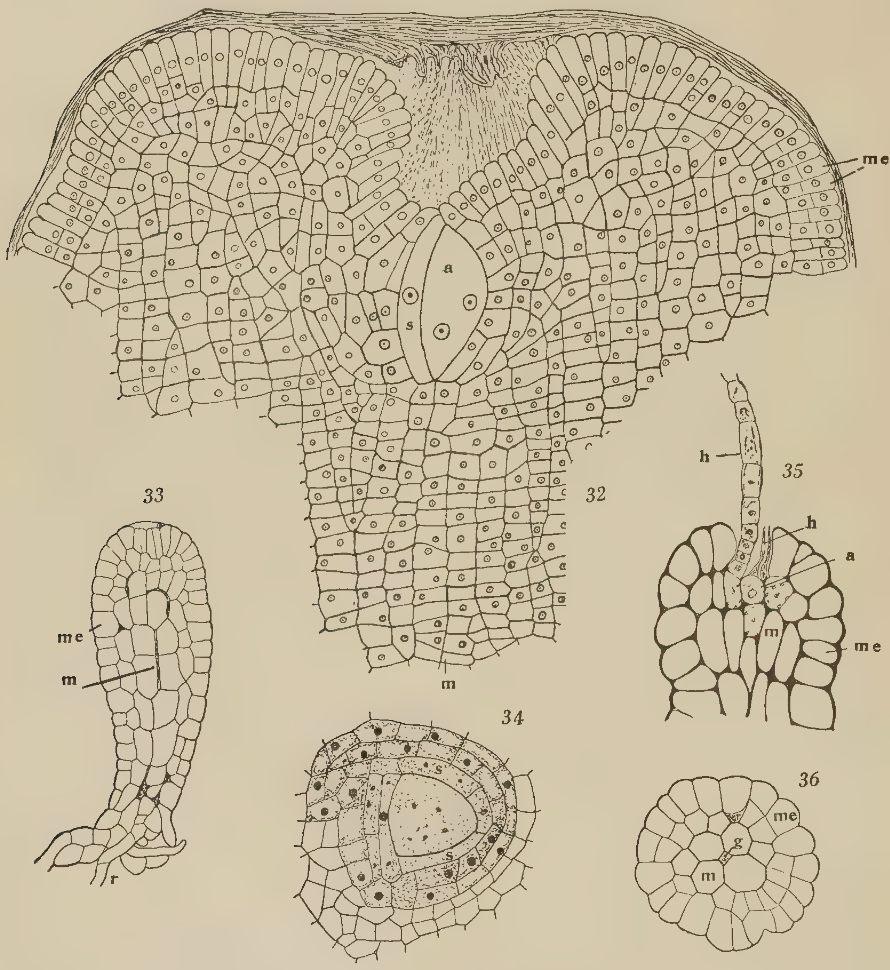
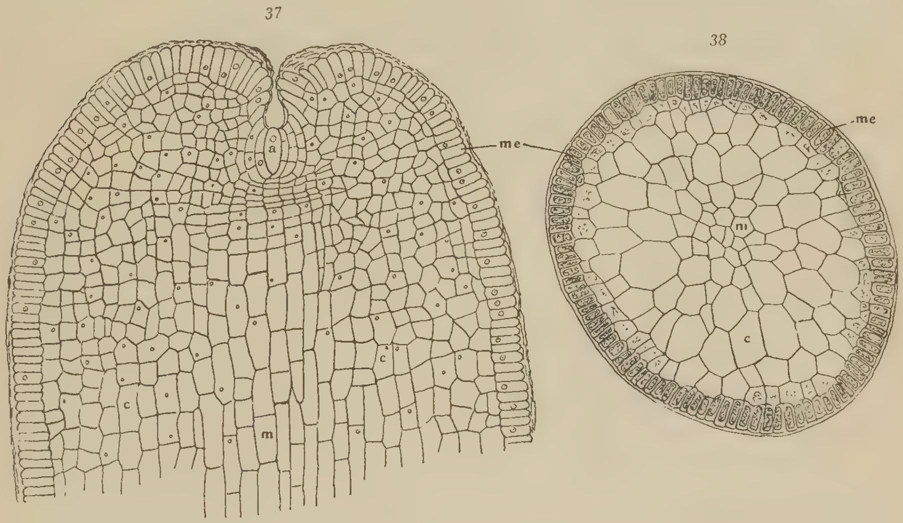
* The view has been advanced that such apical cells, and presumably also those of Dictyosiphonacae, have originated by the lateral fusion of the end-cells of the threads of a multiaxial thallus. For this view, which was originally advanced by Schussnig (1938, p. 309) and has recently been supported by Böcher (1951, p. 18), no adequate evidence has ever been produced and, in my opinion, it would be very difficult to find substantial grounds in support of it.



FIGS. 32–36.—32, 34, *Cystoseira* (*selaginoides* Valiante ?) ; 32, longitudinal section through apical cell and adjacent region ; 34, transverse section through apical cell. 33, 35, 36, *Fucus vesiculosus* L. ; 33, longitudinal, and 36, transverse sections through germlings (after Oltmanns) ; 35, apex of a slightly older germling (after Nienburg). *a*, apical cell ; *g*, mucilaginous wall ; *h*, hair ; *m*, medulla ; *me*, meristoderm ; *r*, rhizoid ; *s*, segment of apical cell. (32, 34 ×285 ; 33 ×170 ; 35 ×about 290 ; 36 ×230.)

There does not appear to be any fundamental difference in the mode of division of the apical cell in the various Fucales examined by me and others. In

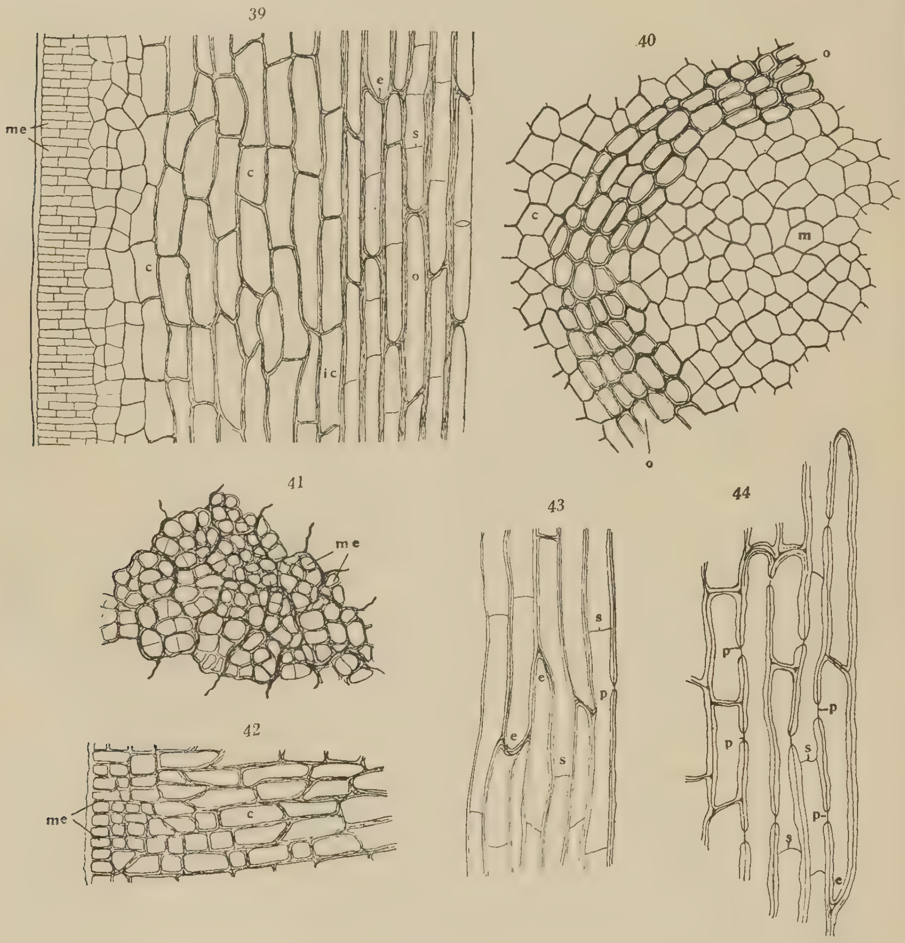
Halidrys (Fritsch, 1945 *b*) and *Cystoseira*, the two genera which I have chiefly studied up till now, comparatively narrow segments are cut off successively (figs. 32, 34, *s*) from its three faces. These at an early stage divide by a number of perpendicular, as well as by more or less horizontally orientated, septa (figs. 32, 37) so that, as seen in longitudinal sections, curved rows of 3–5 cells result. The uppermost cell of each row lengthens to form one of the horizontally stretched elements lining the sides of the pit at the base of which the apical cell lies. The middle cells of the rows, which remain approximately isodiametric, help to build up the mound-like elevation surrounding the pit which also receives increments by the periclinal division of the cells lining the latter. The lower daughter-cells of each segment broaden somewhat and, with some further division, gradually assume a horizontal orientation. These elements give rise to the longitudinal files of flat cells which appear as a conspicuous horizontal plate (fig. 37) a short distance below the apical cell. Although this resembles a meristematic zone, its cells do not, for a time at least, undergo much further division.



FIGS. 37, 38.—37, *Cystoseira granulata* Grev., longitudinal section of apical cell and underlying region. 38, *C. selaginoides* Val., transverse section of a small lateral. *a*, apical cell ; *c*, cortex ; *m*, medulla ; *me*, meristoderm. (×160.)

They gradually lengthen and thus initiate the axial core of pronouncedly elongate elements which becomes conspicuous a little way below the apex and will in the following be spoken of as the medulla (fig. 37, *m*).

A short distance below the apex it is thus possible to distinguish, both in transverse (fig. 38 and Pl. 29, fig. A) and longitudinal (fig. 37) sections, three distinct tissues, which are essentially derived from the division of the segments, cut off from the apical cell. The periphery is occupied by a meristoderm (figs. 37, 38, *me* ; Pl. 29, A, *m*), composed of rather short, palisade-like cells produced by repeated tangential division from the elongate elements lining the apical pit (*cf.* fig. 32, *me*). Beneath it lies a broad cortex (figs. 37, 38 ; Pl. 29, A, *c*), the cells of which generally show some thickening of their walls, but are still for the most part isodiametric, while the centre is occupied by the axial strand, figs. 37, 38, *m* ; Pl. 29, A, *i*), the elements of which already tend to contrast with the cortical cells in their thinner walls and elongate shape. Although in the larger branches (Pl. 29, fig. A) cortex and medulla are far broader than the equivalent regions in *Dictyosiphon*, the differences between them are of a comparable nature, while in the relative arrangement and distinctive features of the tissues, there is appreciable parallel in the subapical regions between such Fucales and mosses growing with the help of a similar apical cell. In the comparatively narrow short laterals, which are frequent in the species of *Cystoseira,* these resemblances are much more marked (*cf.* fig. 38).



FIGS. 39–44.—39, 41–44, *Halidrys siliquosa* Lyngb. (after Fritsch); 39, longitudinal section through lower part of a lateral; 41, surface-view of meristoderm (*me*) from a growing internode, with the outlines of the underlying cortical cells; 42, longitudinal section of meristoderm and part of cortex in basal region of axis; 43, part of a longitudinal section through the inner medulla; 44, part of section through a younger internode of the axis showing transition between cortex and outer medulla. 40, *Cystoseira ericoides* C. Ag., part of transverse section near base of a lateral. *c*, cortex; *e*, thickened end-walls of medullary cells; *ic*, inner cortex; *m*, inner medulla; *me*, meristoderm; *o*, outer medulla; *p*, pits; *s*, septa in medullary cells. (39 ×170; 40 ×180; 41 ×510; 42×250; 43, 44 ×360.)

As we pass from the subapical region to the older parts, however, certain differences become noticeable, differences which are the expression of those distinctive features of the organization of brown seaweeds, already noted in the simpler forms previously considered. They are the result of the activities of the meristoderm, which contributes an appreciable share to the building up of the mature thallus. As in *Stictyosiphon* or *Dictyosiphon* the cells of the meristoderm divide actively by walls perpendicular to the surface so that throughout the thallus they remain small and palisade-like, appearing almost isodiametric when viewed from the outside (fig. 41), while even in longitudinal sections (figs. 37, 39, *me*) they are nearly always about twice as long in the horizontal as in the vertical direction. This extensive division leads to appreciable elongation, accompanied by some widening of the thallus-branches.

At the same time, however, the cells of the meristoderm exhibit more or less frequent divisions by walls parallel to the surface (fig. 39), whereby progressive additions are made to the extent of the cortex (*c*). In much of the thallus of a *Halidrys* or *Cystoseira* division of the cells of the meristoderm, by walls perpendicular to, is a good deal more frequent than division by walls tangential to the surface, and the newly-formed cortical cells tend to become almost at once drawn out in the longitudinal direction, most of them being 2–3 times as long as broad (fig. 39, *c*). The longitudinal tension induced by the often considerable surface growth, which also causes some tangential stretching, of course affects quite particularly the innermost and oldest layers of the cortex (*ic*) where the walls have become more or less appreciably thickened. Here many of the cells become tangentially stretched (*i.e.* somewhat flattened, fig. 40 ; Pl. 29, C, *o*) and very markedly drawn out in the longitudinal direction (fig. 39, *o*). There thus arises around the central, comparatively thin-walled medulla (fig. 40, *m* ; Pl. 29, C, F, *i*), which was formed behind the apex and the elements of which are of course also undergoing lengthening, a progressively widening zone of mostly rather thicker-walled and often somewhat narrower elements which usually show a more or less marked concentric arrangement (Pl. 29, C, D, F, *o*). This zone, which probably fulfils a mechanical function, will be spoken of as the outer medulla. Though always present in the older parts, it is most easily distinguishable when its walls are appreciably thickened, as in fig. 40 and Pl. 29, B, C. Evidence of the longitudinal tension in the inner cortex and medulla in the older parts is furnished by the increasing obliquity of the first-formed septa (figs. 39, 43, *e*), as a result of which the elements often appear markedly dove-tailed between one another. Later-formed septa (*s*), recognizable by their thin character, are usually horizontal.

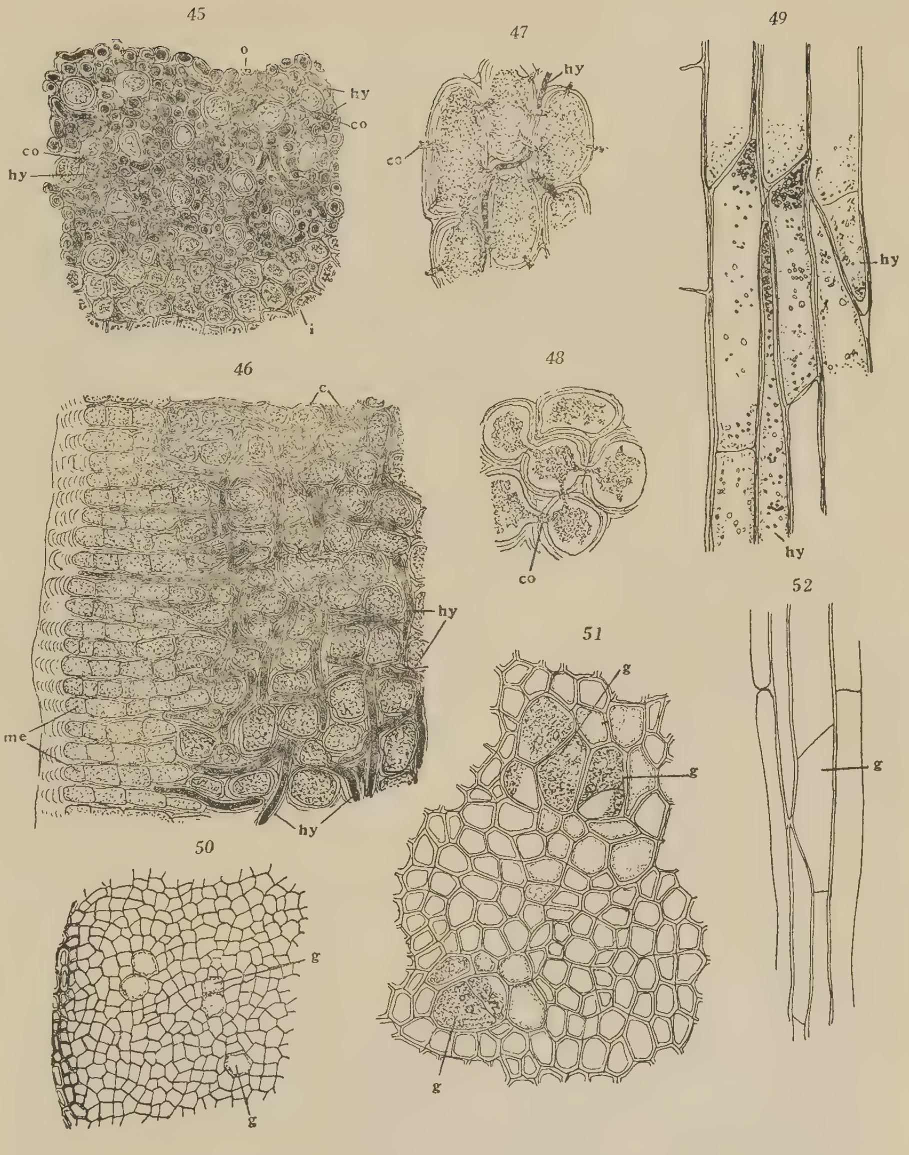
In the neighbourhood of the branches, which are frequent in the Fucales under consideration, the meristoderm of the parent axis often shows at certain points of the circumference more copious periclinal than anticlinal division so that its later-formed products remain horizontally elongated like the meristoderm cells themselves. Such rows of radially elongated and horizontally seriated cortical cells (fig. 42, *me* ; Pl. 29, H, *m*) are also often found in the basal parts of the longer branches and in the main axes (fig. 46 ; Pl. 29, J), especially in the short sturdy ones which are usual in *Cystoseira*. They are in fact typical of regions where growth in length is slow.

The Fucales so far discussed show the structure which is characteristic for most members of the order and, in them, there is throughout the greater part of the thallus no appreciable production of mucilage. The cell-walls, though in the older parts not uncommonly quite markedly thickened in cortex and outer medulla (fig. 39), are firm and all the tissues are compact (Pl. 29, A, C, D. F) like those of an archegoniate plant. The great development of mucilage, which distinguishes the British Fucaceae living between tide-levels and which leads to marked distortion of the fundamental structure, is not typical of the order as a whole. It is to be regretted, and not only for this reason, that *Fucus* figures so widely as an elementary type, since an *Halidrys* or *Cystoseira* would display much more clearly the fundamental anatomical structure of an advanced Thallophyte, and at the same time portray the parallel with archegoniate plants.

The firm construction met with in most parts of the thallus of these two seaweeds is, however, subject to some modification in the older regions where hyphae tend to appear in increasing numbers. They occur near the bases of the longer branches and in the lower parts of the main axes, attaining an enormous development in the neighbourhood of the attachment-discs, in the formation of which they indeed play a major part. Occasional hyphae are frequently recognizable in the outer medulla in somewhat younger parts, where certain of the cells lengthen at one or both ends, the tapering extremities pushing their way longitudinally between the other elements of this tissue (fig. 49, *hy*) and appearing in transverse sections as smaller cells. Such hyphae may be much more abundant in older parts (fig. 45), but the main seat of hypha-production in them, especially in *Cystoseira,* is the cortex (fig. 46) and is always combined with, though not necessarily accompanying, the marked tangential division of the meristoderm and radial seriation of the outer cortical cells to which I have already referred (p. 229 and Pl. 29, H & J). In the older parts of the axes the branching hyphae (fig. 46, *hy*) run in all directions, many pursuing a radial and some even a tangential course (Pl. 29, J, *h*). Those, which run longitudinally, seem in part at least to extend from the axes into the bases of the branches. While in the present state of knowledge it is impossible to say which of several possible functions the hyphae fulfil, their formation in the forms under discussion is no doubt often intimately linked with the origins of the larger branches, and they probably serve to maintain some sort of connection between them and the parent axis.

The hyphae always traverse the thick walls of the cells of the cortex (figs. 46, 47, *hy*) and of the other tissues they invade and, when they are numerous, the cells become thrust apart. The protoplasts of adjacent cells, however, mostly remain linked by more or less numerous connections (figs. 45, 47, *co*) derived from the rather wide pits which are always present in some numbers in the thickening walls (figs. 43, 44, *p*). Such connections are indeed recognizable wherever the walls are strongly thickened (fig. 48). The cell-contents usually project into the pit-canals so that the protoplasts often appear somewhat stellate (*cf.* also Pl. 29, I, J, *c*), but the original pit-membranes are mostly still recognizable between the projections from adjacent protoplasts.

The increasing complexity, which is thus apparent in the older regions of the Fucales, finds still another expression in the species of *Cystoseira* I have examined. The medulla, which consists of greatly elongated, rather thin-walled elements with mainly pointed ends and occasional thin horizontal septa (fig. 52), is uniform in *Halidrys*, but in *Cystoseira* always distinguished by some difference in the width of the component elements (fig. 50 ; Pl. 29, C). In the basal parts of the longer branches and in the axes, however, there are usually present a number of elements which are conspicuous by their greater width (fig. 51 ; Pl. 29, G, *g*), being two or more times as broad as the remainder. These cells generally occur in a variable number of separate groups (figs. 50, 51, *g*), each comprising two or three of these broad elements. It is noteworthy that three groups, more or less symmetrically disposed within the medulla Pl. 29, E, *g*), is a frequent condition. The number and arrangement of the groups, however, commonly displays very marked differences in transverse sections taken through closely contiguous levels, the cells in question being sometimes conspicuous in the one and practically indistinguishable in the other. As shown by longitudinal sections, this is due to the fact that these cells fig. 52, *g*) assume their unusual width often only for comparatively short distances, dwindling both above and below to the breadth of the ordinary medullary elements. These wide elements are often densely filled (Pl. 29, E) with little vesicles and other bodies so that one may suspect a secretory function. However that may be, they are a practically constant feature of the medulla in the older parts of a *Cystoseira* and afford evidence of further differentiation which, so far at least, appears confined to the species of that genus.



FIGS. 45–52.—45, *Halidrys siliquosa* Lyngb. (after Fritsch), transverse section through part of medulla, near base of axis. 46–52, *Cystoseira* ; 46–48, 50, 51, *C. selaginoides* Valiante (?) ; 49, 52, *C. granulata* Grev. 46, part of longitudinal section of axis, with horizontally seriated meristoderm and hyphae. 47, a few cortical cells, in longitudinal section, from the axis showing cross-connections and some hyphae. 48, a few cortical cells from base of a lateral in transverse section, showing thick walls and cross-connections. 49, outer medulla, with two hyphae. 50, 51, transverse sections through central medulla showing large cells (*g*), 50 somewhat diagrammatic. 52, longitudinal section of a little of the central medulla, showing a large cell (*g*). *c*, cortex ; *co*, cross-connections ; *g*, large cells of central medulla ; *hy*, hyphae ; *i*, central and *o*, outer medulla ; *me*, meristoderm. (45 ×335 ; 46, 52 ×185 ; 47–49 ×220 ; 50 ×150 ; 51 ×210.)

The description I have given of the structure of Fucales shows that, in the older regions of the plants, there is an appreciable variety in cell differentiation. Yet, in the younger parts, the same processes are operating as in a *Dictyosiphon*, the primary condition being derived from the segments of an apical cell, while later a secondary contribution is made by the activities of the meristoderm. It is essentially this feature that so markedly distinguishes the organization of the more advanced brown seaweeds from that of archegoniate plants. Why the surface layer in these forms should retain this striking capacity for division, and at one time divide mainly anticlinally and at another also by frequent periclinal septa, is a problem for the physiologist. There are manifestly many differences between it and the internal cells, apart from its direct contact with the sea water.

It is the copious anticlinal division of these cells that conditions the great surface growth and results in the marked tensions between the outer and inner tissues which are often readily demonstrable in the living seaweed. The conclusion that this is the sole cause of the great elongation shown by the inner elements is open to question, and it is more than probable that these may also lengthen by direct growth at their ends. There can be no doubt, however, that the tension induced by the rapid division of the meristoderm plays an appreciable rôle in achieving this elongation.

It is a long step from a *Phloeospora* or *Stictyosiphon* to an *Halidrys* or *Cystoeira*. Yet we have recognized in the two former the early beginnings of a differentiation, becoming much more marked in *Dictyosiphon*, that has led to the relatively elaborate structure of the Fucales. And so I hope to have shown that, by comparative study of a limited number of forms, we can pass by successive stages from the simple to the more complex and thus trace out the probable evolution of a differentiated plant.

I am indebted to Dr. W. T. Mathias for the material of *Phloeospora* and *Dictyosiphon* from which the relevant figures were prepared, and to Mr. R. Cullen, Laboratory Steward, Department of Botany, Queen Mary College (University of London) for the photographs on Pl. 29.

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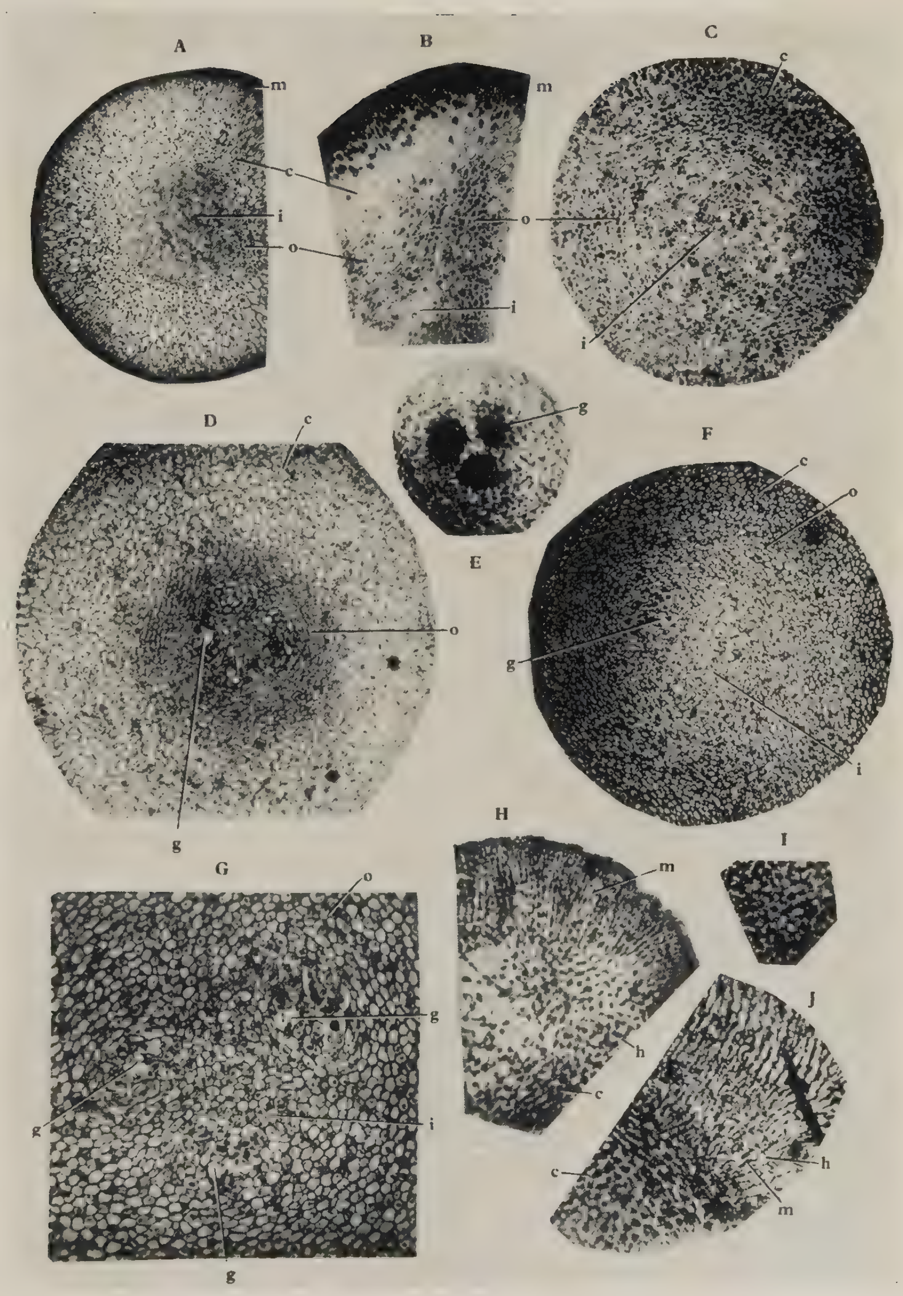
EXPLANATION OF PLATE 29.

Photo *B* is of *Halidrys siliquosa* Lyngb., all the others of *Cystoseira* spp.; *A*, *D*, *E*, *H*, *C. granulata* Grev.; *C*, *C. ericoides* C. Ag.; *F*, *G*, *I*, *J*, *C. selaginoides* Valiante (?). *A*, transverse section of a lateral in which the outer medulla (*o*) is yet little differentiated. *B*, small part of a lateral in transverse section, showing an active meristoderm at the surface, a comparatively narrow cortex, a broad outer medulla and a little of the inner medulla (*i*). *C*, *D*, transverse sections through the basal regions of long laterals showing concentric arrangement of outer medulla (*o*) and large cells (*g*) in the central medulla. *E*, central medulla from base of a lateral, showing three groups of large cells (*g*) with dense contents. *F*, section of bud-like lateral, showing large cells (*g*) in central medulla and



B is of *Halidrys siliquosa* Lynb., all the others of *Cystoseira* spp.

concentric arrangement of surrounding cells. *G*, part of the central part of *F*, more strongly enlarged. *H*, localized meristoderm-activity from base of a lateral, and *J*, ditto from base of main axis, both showing associated hypha-production ; in *J* are seen numerous protoplasmic connections between the thick-walled cells of the cortex (*c*) (*cf.* also *I*). *c*, cortex ; *g*, large cells ; *h*, hyphae ; *i*, central medulla ; *m*, meristoderm ; *o*, outer medulla. (*A–D*, *H–J*, ×32 ; *E* ×26 ; *F*×20 ; *G*×40.) Photos : R. Cullen.

On its conclusion, Professor F. J. Lewis moved ‘ That the President be thanked for his excellent Address, and that he be requested to allow it to be printed and circulated amongst the Fellows ’. The motion was seconded by Dr. John Ramsbottom, O.B.E., and being put to the meeting was carried with acclamation.

The President announced that he appointed the following as the Vice-Presidents for 1951–52 :—Dr. B. Barnes, Mr. H. R. Hewer, Lt.-Col. R. B. Seymour Sewell, C.I.E., F.R.S., and Colonel F. C. Stern, O.B.E., M.C.

Thereafter the President declared the Session of 1950–51 closed.

A FURTHER CONTRIBUTION TO OUR KNOWLEDGE OF CAULIFLOROUS PLANTS WITH SPECIAL REFERENCE TO THE CANNON-BALL TREE (*COUROUPITA GUIANENSIS* AUBL.)

By J. McLean Thompson, Hartley Laboratories, Liverpool University.

(Plates 30–43.)

[Read 26 October 1950.]

Introduction.

While writing recently of *Swartzia* and of its flowering modes, I have remarked how Schimper claimed that when a Cannon-Ball tree begins to flower upon its sturdy trunk, the flowering shoots arise direct from sunken, surface-buds (1, 7). He thought the buds involved were formed in early sapling growth and stood first in leaf-axils upon the slender stem. His view required that most such buds were quickly brought to rest and, as the tree was forming, were sunken in its bark. He thought each added length of stem bore also resting-buds which, too, survived and could be found upon the broadening trunk. He claimed such trunk-borne buds give rise to all the flowering shoots and that the close-investing cork is ruptured as they lengthen. To meet the fact that flowering shoots spring, also, from the limbs, he claimed the latter also bear deep-sunken, surface-buds.

To gain a measure of the bud-reserve which Schimper thought existed, one need but watch a well-grown tree through following flowering phases and note at each where flowering shoots appear on trunk or limb. Most may arise between the stumps of many prior ones : some may be clustered, others raised on little broad-based domes. Some may be near or closely round quite old or recent stumps, and many may be single at intervening points. At each phase, stumps may be observed up to some definite height above which new shoots will appear at slowly rising levels along a length of trunk which shows no sign of prior flowering. Since flowering shoots may also spring quite low on lower limbs, the gap between them and the trunk-borne shoots may shorten steadily. The new shoots lengthened in a phase may number several hundred ; and most of them may be in groups upon the lower trunk. As years advance and bring, in turn, their own new flowering phases, it may prove that the lower trunk is still in active flowering although the tree examined is known to be old.

Such observation may make plain that Schimper's claim required a vast reserve of resting-buds on any trunk which flowers, and that these buds should all be old before their rest is ended, now here, now there, throughout the years of active, rhythmic flowering. It does not seem, however, that Schimper tried to prove that sunken buds existed on trunks of any trees or that such buds form flowering shoots at any time or place. As will appear, his claim has now been tested fairly fully and is still unsupported by any evidence.

The Course of the Enquiry : and Points which were Confirmed.

In 1920, I first searched for sunken, surface-buds on sheets of bark from trunks and limbs of trees of various ages. Three of these trees were said to be some forty years of age and to have been reared from seed near Kingston, in Jamaica (2, 3). The sheets examined were removed at monthly intervals : and, finally, I failed to trace a single sunken bud which might be thought a surface-bud around which cork had formed. Instead, internal buds were always seen beneath undamaged cork. These buds were in the living bark at very various depths ; and many stood in chambers which were entirely closed. The buds were often close beneath the current flowering shoots or in large groups which were remote from shoots of any length. These observations were resumed in 1934 when, also, seedlings and young saplings were seen in North Colombia (4). Once more, no sunken buds were found on any trunk examined though bark from young and flowerless trees was also used repeatedly. It was, however, verified from younger, flowerless trees that groups of buds in living bark are common on the trunks, and that these groups are underneath undamaged layers of cork. And lastly, while in Panama, in 1936, I saw large buds emerging from trunks of sturdy trees and proved they were the sources of many lengthening shoots. I noted that the cork is split before a bud emerges. Many of the slits were circular; and, sometimes, little disks of bark were raised upon the buds or slowly thrust aside. Small sheets of bark were then removed and showed, when sectioned, that buds protruded singly had not been solitary but were the first within the groups to issue from the bark. And since, again, there were no signs of sunken, surface-buds, it seemed worth while to settle what buds could still be found on lengths of sapling stem preserved in 1934.

The distal lengths bore only successive surface-buds, related singly to expanded leaves, or scale-leaves, or leaf-scars. The buds upon the middle lengths were also superficial : some were in pits above leaf-scars, and larger ones were raised ; but all were clearly withered and most were suberized. The only buds which could be found upon the lower lengths were withered and distorted in outer layers of cork. Except along the topmost length, uninterrupted cork was spread beneath the buds and crossed their slender, twisted traces. Internal buds were not observed in any length examined. Thus it appeared that Schimper's claim entirely lacked support and that the view that parent buds of flowering shoots are old must now be reconsidered.

With this in mind, I then employed three oblong sheets of bark, taken from a young and flowerless tree in 1934. There were no stumps of flowering shoots upon the slender trunk or signs of buds emerging from smooth and glistening bark. The sheets were seven inches long and almost four in breadth. The upper margin of the first had stood at three feet from the ground. Six groups of buds, at distant points, were proved in it, within the inner bark. One group contained four large buds ; the others, two or three. Near to the buds, were little groups of very tiny cells, with boundaries so sharply marked that it was obvious that while some groups were spherical, most had a concave face. It was not known till later that little groups like these combine to form internal buds on trunks and lower limbs. The second sheet had been in place two feet above the first and showed it had internal buds at four adjacent levels. Small single buds were recognized at three successive levels ; and several groups of tiny cells were close around their bases. Three clustered buds were at the fourth ; and, scattered widely round them, were many little groups of cells like those already mentioned. The upper margin of the third sheet had stood two feet above ; the bases of some leafy shoots were only slightly higher. I failed to trace a single bud within this upper sheet : there were no groups of tiny cells at points in inner bark.

The bark examined was, at most, 1/40 of the whole between the levels two feet five inches and seven feet from the ground ; and 22 internal buds were in the lower sheets. When surface measurements of bark were used to help in estimation, it seemed that, at the least, 400 buds might well have formed upon the lower middle trunk, and all beneath a surface of almost five square feet. This estimate seemed moderate when it was known, later, that many of the buds in inner bark abort when flowering starts, and that, even then, the lower trunk may flower abundantly. Since sapling stems lose surface-buds wherever cork has formed, I had to think the internal buds had not been organized until the trunk had broadened and that, perhaps, their growth occurred in time- and space-successions. Also, I had to presuppose that, in the course of time, there would be bud-formation along the upper trunk.

To test these notions partly, I first examined records made from older flowering trees, and used some habit-features which had been well confirmed. It had been found that older trees may carry flowering shoots between the levels four feet and ten feet from the ground. When trees had leafy branches which drooped around the trunks, they did not bear new flowering shoots till some low branches fell. The highest new-formed flowering shoots were rarely far below the scars of branches which had fallen, perhaps a month before. The loss of branches had progressed in rough ascending sequence ; and upper levels for new flowering shoots were raised repeatedly. Even when the trees had still retained most higher drooping branches, new flowering shoots surmounted the recent scars of branches and, frequently, still further shoots appeared round many scars which marked the points where branches fell in earlier years of flowering. It therefore seemed the flowerless trunk had only recent buds ; that other buds would organize along its upper length ; and that, in time, it would possess new-formed internal buds at points above the bases of many drooping branches.

The second test required, at least, that proofs should be secured of bud-formation in the bark of trees of various ages. It called for proof of all the steps by which the buds are formed and of the growth of flowering shoots from inner buds alone. This test could not be started till ample bark was studied. I therefore sought and had the aid of Holttum who supplied the needed samples of the bark and wood from trees in Singapore, and even bark from flowerless trees some fourteen years of age. He emphasized that flowering shoots appear at rising levels as loss of drooping branches occurs from year to year. He gave much information on growth and loss of branches and showed how trunks are lengthened as drooping branches fall. He also noted, later, that, when the young trees flowered, the first of all their flowering shoots were on the lower trunks and that, once lowest branches fell, still further flowering shoots appeared upon the middle trunks and at some points not far below the scars of recent branches. Also, I had the generous aid of Asprey who supplied both sheets of bark and lengths of branch from young trees in Jamaica. He noted seasons when the bark was cut and made it possible to study bud-formation upon a sturdy limb. An added debt is due to both of these collaborators for photographs which illustrate some striking habit-features.

The second test is now complete ; and it is fully proved that buds are formed within the bark at many times and levels, and that the upper levels rise as trees increase in age. As will appear, internal buds provide all flowering shoots, including those on major limbs which bear the leafy crowns. The course of bud-formation has now been fully traced, and steps in growth of flowering shoots have all been verified. This article will be concerned with facts which are confirmed; but reference to several points is needed in advance.

The branches of a sapling are formed from surface-buds which all arose on slender lengths of hairy, current stem. Bud-bearing nodes are two years old when cork is formed on them and traverses the traces of buds which fail to grow. A sapling's branches lengthen through several years or more, and many droop around the stem and trail upon the ground. Most surface-buds on branches are in a state of rest until cork forms beneath them, when they are three years old.

The trunks of young trees lengthen by frequent increments until some younger branches extend precociously. These branches lengthen early on upward sloping courses; and permanent limbs are formed from them when trunk-tips have been withered. All other younger branches assume a drooping habit, and some are lengthened steadily through ten successive years. Some distal lengths examined showed cork already formed on nodes which carried resting-buds which might be two years old.

Before young trees begin to flower, their lowest drooping branches show clearly that their growth in length has passed its final stage. The apical buds are shrunken; and hypodermal cork is formed along the distal lengths as quite continuous sheets. It has been found that growth in length of higher branches ceases when they, in turn, are due to fall like older lower ones.

The state of lower branches may therefore indicate if buds are formed or forming on any flowerless trunk. The state of higher branches may lead to fair predictions of upper levels for new flowering shoots on older massive trunks. That flowering follows closely the death of drooping branches may mean this death is solely due to neighbouring bud-formation. I have, then, thought that older trees might still have drooping branches if flowering shoots were on their crowns, as in related plants.

The internal buds to be described are formed in special ways which are, however, partly matched in other flowering trees (2, 4, 5, 6), and have still further parallels in several gymnosperms. Some steps in growth are so remote from those in surface-buds that they create a contrast which calls for special notice.

A surface-bud has unity at every stage in growth; its organs are exclusively the products of its apex. There is no question of some leaves it bears arising independently; much less of small subtended buds existing from the first. Bud-axis is entirely a product of the apex although new tissue forms in it as active growth proceeds. There is no question which could rise of apex, leaves and axis combining in a surface-bud to cause its unity. Such questions are, however, raised by all internal buds which form at any levels on trunk and limb alike.

As will be shown, the large internal buds are always composite; and many small buds are combined when any one is forming. Some of the steps need mention here; and details are reserved until this article presents the proofs of all the steps in growth.

Before an internal bud is formed, small meristems arise at many points at several depths within the living bark. The meristems originate from nests of cortical cells which sub-divide repeatedly until each nest becomes a little mass of tiny cells which can divide again. The outlines of the meristems are so precisely marked that one might almost think their masses are engulfed in bark and clothed in parenchyma. Most of the meristems are very small and have a concave side. The remaining few are large and round and are at scattered points, but always have, as neighbours, some concave meristems. Wherever larger meristems have concave neighbours near them, large internal buds may be composed within the living bark, As will appear, small buds are formed from many concave meristems: but bud-leaves and the growing points are seldom freed in chambers. Tangential sections of the bark will show that many smaller buds encircle every large bud so closely that it is the central member of a group of independent buds. The encircling members of a group supply an internal bud with all its tiny lateral buds, no matter what their numbers. It can be stated truly that all the buds involved are formed simultaneously within the living bark.

A large internal bud has outer ' leaves ' which owe their total number to that of all the lateral buds which organized before them. They are, indeed, the last of all the organs to be formed, and also need some comment before the proof is given that they are not created as products of an apex, but are small strips of torn bark which seem, at first, adherent, as if cement united them along opposing faces. The separation of the strips begins in cortical cells above the ' central ' bud and is continued downwards on spiral sheet-like paths which lengthen until lateral buds are passed to right and left. The lateral buds are then within the bases of the strips so that one might imagine that each bud was engulfed and was invested closely by large-celled parenchyma. The arrangement of the strips suggests a definite phyllotaxis like that of formed and forming leaves in any surface-bud. As will be found, I call these strips the *prophylls* of the ' buds ' which first emerge from ruptured cork when flowering shoots are forming at any level on a trunk or on a sturdy limb.

The axis of an internal bud is formed by transformation of all the body of the ' central ' bud and is not, then, produced by growth direct from growing-point, as in a surface-bud. To all intents and purposes, the growing-point is resting while active cell-division proceeds throughout the body which comes to be extremely large and often spherical. The axis is completed when cell-division halts except around the margins and near the lateral buds. Once lateral buds and prophylls and axis are combined, a large internal bud is formed within the living bark.

Some further points of contrast need also special mention since they arise in early steps of flowering shoot-formation. Before commenting on these points, I shall propose to call the base of an internal bud the active *pediment* since, as it proves, a flowering shoot is based directly on it and has a lower length which lies within the living bark and is produced exclusively by intercalary growth.

The growing-point is resting when shoot-formation starts; but cell-division is resumed within the pediment. It is most active in the lower part, and even underneath, and comes to be continuous beneath the lateral buds. The pediment becomes, in fact, a special meristem; and, soon, a cambium is organized beneath it and within it. Some products of the cambium are on its outer side: and since these product-cells enlarge and form a column of tissue, the prophylls, lateral buds and growing-point are raised progressively. Although the column lengthens by basal increments, it stays united to surrounding bark along its total length. The bark is damaged only above the uplifted prophylls since general cell-division begins around the column and is repeated, step by step, as lengthening proceeds. It will be shown that strands of bast arise within this bark and form a mantle to the column when growth in length has ceased. The column lengthens steadily until the bark and cork above the prophylls have been torn and all bud-organs rise through fractured cork and are exposed as one united group. The group is so compact and broad that one might well imagine a simple surface-bud is raised from mantling layers of cork. It will be found that woody strands are formed within the column when apical growth is started within the group exposed.

The final points of contrast which need some special mention relate to prophylls, lateral buds, and to some other buds, and to the freeing of the growing-points from all their covering tissues.

Although, at first, the lateral buds are in the prophyll-bases, it will be shown they come to be entirely superficial and placed in little ' axial ' pits of various depths and breadths. These changes are prefigured when once a sloping split develops on a prophyll-base and towards the bud within it. The split is deepened steadily until the bud is reached and its small, flattened apex has been entirely freed. The split develops downwards so that a little flap of leaf-base tissue is defined and overhangs the bud. This flap is like the *ligule* which forms in many lycopods; and neighbouring bases separate before it is destroyed. There will be proof that prophylls grow until they separate and that they shed their pointed tips when all have been exposed.

It seems the lateral buds remain in lengthy dormancy and play no part whatever in growth of flowering shoots. The flowering shoots arise direct between the expanded prophylls from growing-points with forming leaves and axial buds beneath them. The proofs of this will all be found in earlier articles which deal with flower-development in several allied plants (2, 3). Throughout the growth of flowering shoot, all lateral organs form as products of an apex, as in a surface-bud.

It will be found that many buds remain in independence and, seemingly, are resting at various depths in bark. They free their tips like lateral buds within the prophyll-bases : but prophylls are not formed with them at any stage in growth. Small flaps of tissue are detached above their apices and do not fall, but are destroyed by slow disintegration. In this respect, these buds resemble tips of compound buds which also have such tissues above their growing-points.

There are, then, many differences between the internal buds and surface-buds with naked tips at every stage in growth. In turning to the proofs required for points which have been raised, I should express some final views on all the evidence. They are that buds which now combine might keep their independence : that prophylls would not then be formed in bark at any time : that every unit bud might yield a flowering shoot directly if growth were active in its base and raised its growing-point : and that, if surface-buds remained on broadened trunks and limbs, they could be used in flowering, as in related trees.

SOME POINTS OF EVIDENCE.

1. *Some features of a sapling and of a flowerless tree.*

The evidence of saplings and young trees is required to underline some features of growing stems and branches and indicate where surface-buds exist on flowerless trees.

A sapling's stem is slender and tapered towards its tip. Its new-formed lengths are hairy and mainly rather long and have small awl-shaped lower leaves which seem to alternate. The larger leaves are crowded below the apical bud ; and they expand together when growth in length subsides and scale-leaves have enveloped the broadened bud above them. The margins of the leaf-blades are very finely toothed ; and slender downy hairs persist on nodes and internodes long after current leaves are shed and all their scars are sealed. The larger leaves are lanceolate and of most varied size, and each subtends a single bud which may produce a branch. Most of the lower buds are small, and very few are active : some grow to little slender twigs which are ephemeral. Persisting branches are derived from larger upper buds which lengthen rapidly before the stem has added to its length. New lengths of stem are furnished in every rainy season so that the growth of several years may make a sapling tall. The lower length of stem becomes a slender, upright trunk when all the first-formed branches are withered and have fallen. The trunk is clothed completely in smooth and thickening cork which covers also lower lengths of all the higher branches which are retained upon the trunk and have thin woody bases. Sometimes, the remaining branches are lengthened intermittently, especially if new-formed stem is growing rapidly. The rate of branch-growth may be slow until the stem is tall : it is, however, evident there is a later stage at which the trunk-borne branches begin to lengthen rapidly in downward, drooping manner. The added lengths have larger leaves around their apical buds and carry single axial buds at all their nodal points. Most of these buds seem resting, and many die and shrivel when cork is forming under them in thin and perfect sheets (Pl. 34, fig. 22). Quite often, two new upper buds form side-shoots rapidly but grow more slowly than the branch-tips which are still dominant. Some single upper buds, on branches grown long, form side-shoots which grow actively and make the branches fork or come to be sympodial along their final lengths. Since many branches lengthen through ten or further years, their final lengths are straggling and trailing on the ground when young trees are established and trunks are growing broad (Pl 30, fig. 1). While branches lengthen steadily, their apical buds are broad and have an outer covering of stumpy, awl-shaped leaves (Pl. 30, fig. 2). The larger leaves beneath these buds are of most varied size and are, then, like the distal leaves on sapling-stems and -branches (Pl. 30, fig. 3). While branches are in active growth, their current shoots are hairy, and apical buds are broadened as soon as they extend (Pl. 30, fig. 4). It is a sign that branch-growth is in its final phase if hairs are lost immediately when larger leaves expand and—as it proves—the new-formed shoot is quickly clothed in cork which is extended upwards above the petioles (Pl. 30, fig. 5).

The final state of branch-tips is better understood if they are sectioned lengthwise and tissues are examined. It will be found that apical buds are structurally perfect ; but even their smallest leaves are brown and partly suberized. Broad hypodermal cork will stretch along the full tip-lengths : but there will be no cambium beneath its inner layer. This cork is even formed along the topmost internodes and ends directly underneath the altered apical buds (Pl. 33, fig. 19). The skin of every internode is shed with all its hairs, as if it was a membrane which had been stretched and freed. The petioles of upper leaves are soft and fairly hairy : the axial buds are sometimes large or have already formed short spur-shoots with small, narrow leaves which are excised by cork (Pl. 33, fig. 18). If branch-tips have been sectioned in strictly transverse planes, broad cork will also be confirmed on all the upper nodes, as if extended round them from petiolar bases (Pl. 33, fig. 20).

Since recognition of this final state in lower trunk-borne branches can help to show if younger trees will soon begin to flower, the evidence of saplings is needed to confirm that tips of growing branches are in a different state. If tips of growing branches have fully elongated, thin sections through their lengths will show that compact cork has formed along the lower internodes which still retain their skin (Pl. 33, fig. 17). The upper limit of the cork on any lower internode will be below a small leaf-scar with rough and sloping surface. Above the scar—as shown now—will be a sunken bud which, like its nearer neighbours, appears to be at rest. The only cork which will be traced from high mid-points to apices is leaf-scar cork where smaller leaves had been the last to fall (Pl. 33, fig. 16). Even if the hairs have all been shed from upper middle internodes, their bases will be evident within undamaged skin as little groups of deep-stained cells at rather scattered points (Pl. 33, fig. 16). The topmost nodes and internodes will be extremely hairy as also will be covering leaves of all the apical buds. Whilst cork on branch-tips in their final state is formed once-for-all, when nodes of current branch mature, new cork is forming on them (Pl. 34, fig. 21).

I have not then considered that branches fail to lengthen at some chance time when they are old and have grown very long. It has seemed, rather, that each fails to grow at some quite definite stage when flowering shoots are forming on the trunk below its woody base.

2. *Some tissues of a flowering trunk.*

Before attempting any proof of steps in bud-formation, I should refer to tissues on young and narrow trunks. The surface of a trunk is smooth since many layers of cork have formed without a fracture or gap at any point. The cork is lined by phellogen which yields internally a little tissue which matures as large-celled parenchyma, with intermingled stone-cells in groups of various sizes. This tissue's inner limits are never clearly marked: it joins the cortex to compose the narrow living bark. The underlying bast is broad and is continuous except outside the wood-rays where none is organized. Outside each ray, the cambium yields a mass of parenchyma which broadens outwardly and deepens by intermittent growth. This mass has no clear limits against the bast around it and merges imperceptibly with narrow covering bark. The total mass resembles an outward-widening funnel: the ray internal to it is like a funnel's tube. I call the mass a *ray-mouth* because of its position although it owes its origin, in part, to pericyclic tissue. To all intents and purposes, it comes to be be a part of all the active living bark on any broadened trunk. Since larger ray-mouths come to be the matrices of buds, some tissue-changes in them should be, at least, confirmed.

3. *The transformation of a ray-mouth : and meristem-formation.*

The tissue in a ray-mouth is always parenchymatous until some meristems are forming within its outer region. It then becomes most obvious that narrow, curving cambia are organizing lengthwise and that, when they have formed, they will be like tangential sheets which cross the outer tissue. The tissue added by a cambium is formed centripetally so that adjacent cambia are rendered far apart except along the margins which may be confluent. Each mass of added tissue is more or less lenticular and makes a ray-mouth broaden more than deepen outwardly. The total mass may be matured as large-celled parenchyma without clear inner limits except where cells have swollen walls or have become compressed (Pl. 34, fig. 25, centre and left). When cell-formation ceases, a cambium is transformed to small-celled parenchyma with rather swollen walls (Pl. 34, fig. 25, centre). When any cambium has furnished internal rows of cells, the components of adjacent rows may subdivide repeatedly until a meristem is organized with definite size and form (Pl. 34, fig. 25, low right). A row of separate meristems may be the final product before their parent cambium has lost identity. If growing-point is forming for any meristem, it will be just above a group of small dividing cells which is apparent, always, before a bud is formed (Pl. 34, fig. 25, low right). A curved, lenticular meristem, four times as broad as deep, may be the major product of any cambium (Pl. 34, fig. 25, high centre). There may be several growing-points at well-spaced intervals above internal groups of cells which are in subdivision. A large lenticular meristem, is, later, subdivided when radial sheets of little cells between the growing-points have broadened greatly and mature as large-celled parenchyma.

New cambia are organized in tissue formed by others and also in a widening field which may be bi-convex and does not seem to change its shape until some buds are formed and cause distortion of the tissue around and over them. The locus of a widening field is easily conceived if one imagines that a funnel's rim is covered by a lens which blocks the entrance fully and fits it perfectly.

The new peripheral cambia are often far apart so that there are, between them, broad bands of parenchyma. Although they are convergent, they may remain apart or have their margins confluent at rather distant levels. It seems that few are active in forming outer products and that some fail to function and change to parenchyma with swollen outer cell-walls to mark their transformation. Since single meristems are organized mid-way between these cambia, the intervening tissue appears to be their source.

4. *A field of meristems: and the origin and features of compound buds.*

While meristems are forming throughout a broadening field, parts of the matrix-tissue are growing intermittently. They may be deep within the field or near its spreading margin, but show no sign of cambia at any stage in growth. The component cells of any part divide and then enlarge and may divide again until a bulging tissue-mass is fully organized. No matter what its shape or size when general growth subsides, each mass is parenchymatous and has its outline fixed by broadened, twisted cell-walls in one continuous sheet. Each mass becomes a minor field which yields a group of meristems: these come to be a system which may compose a bud. Most of the members of a group are small and almost ovoid and are arranged most orderly around a 'central' one which is, most often, very large and is a perfect sphere (Pl. 37, fig. 34). Each little meristem is in a zone where growth was concentrated so that the final limits of all the zones are marked by sheets of plastic cell-wall which broaden as they stretch (Pl. 37, fig. 34, 1–6). The sheets are curved and, when complete, are confluent in pairs so that each pair encloses a mass of parenchyma from part of which a meristem has organized directly. Each of the little meristems in bounded parenchyma has flat or concave inner face directed towards the sphere. More distant members of a group may be in bounded tissue but may have concave faces turned to right or left, or outwards.

Since single sections cannot show how many little meristems are grouped around a sphere, I should attempt to visualize a common type of group which has been proved repeatedly through serial transverse sections.

One may imagine that the sphere—with parenchyma round it—is in a tiny urn and fills its cavity. The urn-wall imagined is multi-laminate, consisting of curved, leaf-like sheets arranged like leaves on a spiral so that the tips of outer sheets define a narrow entrance which is, however, fully filled by large-celled parenchyma. To follow any single sheet from base to narrow tip would need a circuit of the urn before the tip is reached. One may conceive that each sheet-base contains an ovoid meristem and that, whilst bases of the inner sheets are close around the sphere, those of the outer sheets may be quite high upon the wall. Thus if the urn was cut across in any lower plane, the section would traverse the sphere and every inner sheet-base and, at the least, some meristems which were in inner bases (Pl. 37, fig. 34). Cross-sections at most higher levels would show some outer bases and several outer meristems and, also, lengths of many sheets which help to form the wall.

Comparison of many fields has made it evident that only independent meristems arise in any field until some minor fields are formed within its own confines: that, where a minor field exists and yields a group of meristems, some members of the group will constitute a clear and ordered system: that every system will comprise at least one massive sphere and smaller lateral meristems in leaf-like sheets of tissue which all supply the prophylls of massive compound buds: that apices of compound buds are formed direct from spheres: and that the smaller meristems mature as lateral buds. The total product of a minor field may be a single bud which shows, in mid-long section, some lengths of curving prophyll (Pl. 37, fig. 35, P) and several lateral meristems enclosed in prophyll-bases, and with their concave faces towards the apex of the bud.

5. *Some points of variation.*

When many independent meristems have formed in a field, it is no longer easy to judge which may be old since no one can determine where cambia had existed or judge which tissue-boundaries were recently defined. It is, however, certain that many separate meristems enlarge until they are like small imperfect saucers which often have vague, incurved rims and rugged inner faces. Their faces may be fully freed from pegs of parenchyma or may be parted from them at only single points (Pl. 39, fig. 40). Still further meristems form domes or mounds which fail to free their surfaces (Pl. 39, fig. 41, A), whilst others are arrested as narrow sheets of tissue with torn chambers over them and widened outwardly (Pl. 39, fig. 41, B, C). Some other meristems are very large and have small, rounded neighbours which are, most often, scattered without a sign of grouping. The common products of the large spheres are buds of various sizes with rim-borne, leafy outgrowths around flat growing-points. The growing-points and outgrowths are always freed together by simple separation from covering parenchyma (Pl. 38, fig. 37, B). A rounded neighbouring meristem may be in bounded tissue, suggesting that a lateral bud and prophyll might be formed (Pl. 38, fig. 37, M) and could then join a neighbouring bud and end its unity. Most of the small, round meristems mature as tiny buds which always have their growing-points upon their outer faces, but rarely free their outgrowths from covering parenchyma.

Thus any field which has enlarged by many steps in growth contains not only compound buds and independent meristems but also numerous unit buds of very varied sizes. The field is intersected by sheets of broad cell-wall which pass between the meristems and curve around the buds and may persist till after some compound buds enlarge and flowering-shoot development has started in a field, and woody strands are forming beneath the major buds (Pl. 36, fig. 33, L and S.S). Some further features of the compound buds are worthy of attention since they affect the unity which is conferred on them.

When any minor field is cut in serial transverse sections, all meristems within it can be reduced to plan so that their sizes and their forms and spacial relationships may be considered and compared with those in other fields. Curved lines may represent the sheets of broadened, bounding cell-wall, and blackened curving masses the lateral meristems with inner faces turned towards a massive sphere or apex (Pl. 36, fig. 31, A, L). The final product of the field now shown would be a unit bud, with apex not quite central (L), and with some lateral buds and prophylls quite close around the apex, and others distant from it. Such compound buds are common and, often, of great size and may possess from 60 to 80 lateral buds.

The meristems in minor fields may not be simple systems with single spheres as focal points for all the lateral meristems. The spheres may number three or four and be of equal size, or one may be much larger than others in the field (Pl. 36, fig. 31, B, 1, 2, 3). Each sphere is then a focal point for smaller neighbouring meristems so that, whilst few have inner faces towards the smallest sphere of all, the larger spheres are focal points for all remaining meristems. Three compound buds of different size could be the final products : the apices of larger buds would, clearly, be eccentric (Pl. 36, fig. 31, B, 1, 2). Such groups of compound buds are formed in many minor fields. Most commonly, the largest buds become the active leaders and others are subordinates, with some delay in growth, when flowering shoots are forming on trunks of younger trees.

6. *The fields with buds and meristems.*

When broadened ray-mouths have been cut in virtual radial planes, they may show some examples of little buds which formed from rounded meristems, and also little meristems which could form further buds (Pl. 36, fig. 33, B–B and M–M). The margins of an active field may not be very evident but will be near such levels as are numbered 1 and 2. The bast around a ray-mouth will be in parallel strips (PH–PH), and many nests of stone-cells will be in inner bark ; and sheets of stone-cells will have formed not far beneath the cork (solid black). The prophylls of a leader-bud (L) may all have freed their surfaces within an irregular chamber which has been fully opened to outer air and light by tearing and destruction of covering bark and cork. This freeing of the prophylls is, doubtless, premature and seems to be related to cambial activity beneath the bud and to arrest of growth within its body which would provide a pediment if flowering shoot were forming. The cambial zone is very deep ; and many layers are active and, thus, envelop inner buds and little meristems which chance to lie within it or near its widening fringe. It furnishes fine, woody strands which link, internally, with many others organized when leader-buds were formed but had no vasculation around their broadened bodies. Each body comes to have a fringe of fine tracheidal strands (L and S.S) and, later, has procambial strands around its central massive of very tiny thin-walled cells which seem to be at rest (Pl. 34, fig. 23). Some prophylls are distorted or partly suberized whilst others may be tender and hairy near their tips (Pl. 34, fig. 24). The lateral buds are shrunken, distorted, and displaced but may be evident, from time to time, close to the prophyll-bases (Pl. 34, fig. 23, right). It seems that many leader-buds fail at this stage in growth but that their structure is unchanged through several years, or more. At least a few are later clothed in narrow sheets of cork and thus remain near little buds which rarely gain in size and never fracture covering bark or grow to flowering shoots. It should, then, be confirmed how normal growth proceeds and, first, how lateral buds are formed, and that they are unchanged until the prophylls separate when they are carried outwards through bark and fractured cork.

7. *The formation of lateral buds and prophylls.*

As has been shown, a massive sphere has meristems around it wherever any compound bud is forming in a field (Pl. 37, fig. 34). Full serial sections make it plain that tissues on the inner sides of many lateral meristems mature as parenchyma, and that the tissues on the outer sides provide the forming buds (Pl. 37, fig. 34, 1, 2, 3, 5). The total parenchyma formed is sometimes clearly shown (Pl. 37, fig. 34, 1, 2, 3) but cannot be determined by well-marked boundaries when outlines of the prophylls are fairly evident. Wherever massive compound buds are forming in a field, cross-sections show some stages in growth of lateral buds (Pl. 38, fig. 38). The arrow gives direction towards the centre of the system. Two outlined prophyll-bases are crossed at B and C. The bud in B is traversed in almost median plane and shows, in full, the form and state attained by lateral buds until the prophylls have been freed and they have been exposed. It has a small, flat growing-point and broad, incurving rim and is united fully to large-celled parenchyma. The forming buds in A and C are traversed towards their margins : each has an indentation where growing-point will stand : beside the forming bud in C is inner parenchyma which fills the indentation and clothes the inner face. Thus, as components of a compound bud become coordinated, the lateral buds are organized in no precise succession until they all have growing-points and broad, incurving rims. Even when the apex of a compound bud is freed from covering tissue, the formed and forming lateral buds are clothed in parenchyma (Pl. 37, fig. 35).

8. *The uplifting and exposure of the organs of compound buds.*

I should revert to features shown in fig. 33 (Pl. 36) and notice that, although the local cambial zone is under major buds, it could embrace and modify the bases of their bodies and still yield many strands of wood like those which are below them. Since these conditions are fulfilled in many broadened fields, the organs of the major buds remain beyond the cambium and are all still united to unchanged upper parts. Fine strands of wood are organized from inner cambial products; and since the cambium is active in forming outer products, the organs of the buds are raised in measure with its growth.

Surrounding bast is plastic and can allow for growth and is assisted in this by local cell-division. The organs of a group of buds are, therefore, raised directly until their final barrier is broadened, covering cork. The cambium continues to furnish outer products until the cork is ruptured and organs of a leader-bud are partially exposed, whilst those of the subordinate buds are still within cork. The organs which have been exposed are closely overlapped so that one might imagine a sunken bud has risen through mantling cork or has been perched upon a cork-clad dome (Pl. 31, figs. 7, 8). The growing-point and outer prophylls of a major bud are hidden in the rupture which is extending downwards to varying depths in outer bark and, thus, defines a tissue-column within the outer bark, with prophyll-bases on it, in one ascending sequence. In contrast to the organs which suffer great displacement, the bases of the major buds rest more or less in place, although they have been altered to portions of the cambium, and early form and structure are totally effaced. Each has, however, founded a heightening tissue-mass and adds new tissue to it so long as growth proceeds. It is the active pediment from which the mass arose and has, throughout, been adding most to underlying bark.

9. *The initiation of flowering shoots: their vasculation and new fields for meristems.*

A ray-mouth broadens greatly if major buds within it initiate young flowering shoots through active apical growth (Pl. 42, fig. 47). The breadth of ray-mouth shown extends from M^1 to M^4. The field is very shallow and rich in marginal meristems which, mainly, are aborted or have remained at rest. The major buds were central and were in place, at first, between M^2 and M^3 and, doubtless, at the level of these two lettered points. The lower length of upright shoot (L) protruding from the cork (solid black) is clothed in little 'leaves'. These are the prophylls of the leader-bud from which the shoot arose. Their surfaces are mainly freed; but all the outer prophylls are basal on the lower length which rises from a chamber. This length arose by growth within the massive tissue-column which was defined when outer bark was ruptured inwardly and caused the chamber to be formed and fixed its depth and breadth. The upper length of upright shoot with compact, crowning bud was formed entirely by the growing-point which all the prophylls hid until the apex of the leader-bud had ceased to be at rest. The organs of a subsidiary bud (S) are all within the chamber. Some of the prophyll-bases show lateral buds within them (P): some of their free tips overarch the resting growing-point. Tracheidal strands are forming beneath the subsidiary bud. A tube of formed and forming wood is in the upright shoot and is extended inwards through tissues of the ray-mouth until it joins the outer wood which formed within the trunk.

While tubes of tracheides link the shoots to outer sheets of trunk-wood, some changes are in progress, deep in the living bark. The tissue round tracheidal links is altered, here and there, to flat or ovoid meristems in bounded parenchyma (Pl. 42, fig. 47, A, B, C). The meristems are few at first, but, later, fairly numerous, so that new fields become defined beneath the older ones. It may suffice to notice here that new fields organize and are, in time, the sources of many flowering shoots. A second change is evident when many little strands of latex-tubes are forming around tracheidal links and also at quite distant points within the broad ray-mouths (Pl. 42, fig. 47). It must suffice to underline that, when this change is ended, the shoots are vasculated and flowering is begun, and to refer to several steps which always are involved. A tracheidal tube which has been formed below a lengthening shoot is almost fully clothed, in time, in radial sheets of phloem. The phloem is linked to narrow strands of little latex-tubes which organize beyond its fringe and come to be connected. When many strands have been matured, they form a phloem-mantle which, duly, is extended along the length of tube except beside a new field and in the upright shoot. The mantle is developed, first, close to the functional cambium and is connected there to bast across the ray-mouth's margins. Cross-sections at this level show how any link matures (Pl. 42, fig. 48), with tortuous strands of tracheides inside a narrow cambium which is, in turn, invested in radial sheets of phloem. They also show how mantle-strands (PM) compose an elaborate plexus and join investing sheets of bast (PH–PH) through many marginal strands. When similar connections are made at higher levels, the basal lengths of young shoots are rapidly extended, and tips of upraised prophylls are suberized and falling (Pl. 36, fig. 32, P–DB). The tender middle lengths of shoot bear mainly leafy buds (VB) ; and large flower-buds are forming along the distal lengths (FB). The growth of shoots does not prevent new meristem-formation (M–M), so that, when shoots have withered, they may all be replaced.

10. *The separation of prophylls and the freeing of lateral buds : the ligules.*

It should be shown how lateral buds are finally exposed and proved that prophylls are alive until their tips are freed and ligules over lateral buds are broken or destroyed. I should, however, first recall that young prophylls are curved so that thin sections through a compound bud do not expose their lengths (Pl. 37, fig. 35). Their curvatures are lessened when some have freed their tips and they resemble scale-leaves around an opening bud (Pl. 31, figs. 7, 8). The lateral buds are still within their tender, narrow bases when many are uplifted on basal lengths of shoot (Pl. 42, fig. 47). Before these lengths have been defined by deep tears in the bark, the overarching prophylls diverge and partly straighten. Cross-sections, at the latter stage, through outer bark and cork, should show some lateral buds enclosed in basal lengths of prophylls and tips of inner prophylls which have been fully freed (Pl. 38, fig. 39). This figure does not sample the tissues of the column round which the prophylls had remained in close, ascending group. The figure shows a meristem (M) and several groups of stone-cells (S–S), and—near the centre—broad cell-walls which, doubtless, mark a cleavage-line between the bark and prophylls. High on the left, a prophyll-tip is almost fully freed : some of the prophylls under it are cut in basal lengths (P–P). Since prophylls curve in upward course, these lengths appear lenticular. The lateral buds in three of them are towards their narrow bases. The lowest bud is traversed in almost median plane so that its upraised margin and growing-point are shown. Comparison will make it plain that, even at this stage, the lateral buds are resting or have retarded growth (viz. Pl. 38, fig. 38). The adaxial flaps or ligules upon the prophyll-bases (L–L) are outlined at this stage in growth by sheets of broad cell-wall which are extending downwards until they reach the buds at marginal points which vary according to their courses and to the levels of the buds within the basal lengths.

The prophylls do not separate along opposing faces until the column has been freed from all surrounding tissue and has been broadened and become the basal length of shoot (Pl. 42, fig. 47). The outer tissues of this length mature as sclerenchyma while internodes are lengthening between the prophyll-bases (Pl. 39, fig. 42, A, B). The lateral buds are sunken, as broadening proceeds, and free their growing-points and rims in very tiny chambers (Pl. 39, fig. 42, A, centre). The upper lengths of prophylls are always freed directly and look like little awl-shaped scales when they have been enlarged and all their tissues are transformed to thick-walled sclerenchyma (Pl. 39, fig. 42, A, right). Their middle lengths are sunken, and often lose their outlines : their deep-placed lower lengths are always well-defined as lenticles of tissue with buds at inner ends (Pl. 39, fig. 42, A, centre). Exposure of the buds begins when inward splits develop where upper faces of the scales are merged in sclerencyma. A split may pass above a bud and reach its inner face (Pl. 39, fig. 42, B) or fail to tear the chamber-wall, if ligule is displaced to right or left, and is not shown in sections in almost median planes (Pl. 37, fig. 36, A). A chamber-ceiling fractures and may disintegrate but often leaves its remnants above the growing-point (Pl. 39, fig. 42, B). When ligules have been sectioned along their greater lengths, they may be seen to cover the growing-points and rims (Pl. 37, fig. 36, B). The middle lengths of prophylls which have remained united are greatly widened during growth within the broadening nodes. Thin absciss-layers are organized across their outer zones when inward splits are deepened towards buds in prophyll-bases (Pl. 37, fig. 36, A). The sclerotic scales become detached from broad abscission-tissue (Pl. 39, fig. 42, B) ; and when this tissue also falls, the stumps of middle lengths are sealed in sclerenchyma, whilst lateral buds enlarge (Pl. 37, fig. 36, B). Thus, basal lengths of heightening shoots are clothed in sclerenchyma ; and lateral buds are ' axial ' to scales or stumps of scales when chamber-ceilings have been torn and growing-points exposed (Pl. 36, fig. 32, basal length DB). The lateral buds are dormant while flowering is in course and are unchanged when flowering shoots have left broad, ragged stumps. I do not think they ever grow to minor flowering shoots or are developed further than minor buds with rims.

11. *The isolation of arrested buds.*

There is no certainty that flowering shoots will spring from any field even though it has a number of compound buds within it. While some buds fail completely when they have been enlarged and freed their total prophylls in wide unopened chambers, the growth of neighbours may be stopped at some late stage in growth (Pl. 40, fig. 43 and Pl. 41, fig. 45). These figures show a broadened field in nearby transverse sections and illustrate especially how buds may be arrested. The field contains a leader bud (L) and two subordinates (S.S) and, at the least, three compound buds in marginal positions (A, B, C). The prophylls of the central group are freed and suberized (solid black) : the unchanged bodies are composed of small-celled parenchyma (white). The subsidiary buds are not traversed in fig. 45 which shows a margin of the leader-bud (L) and parts of outer propyhlls. A complex tissue-system has formed beneath the group which lacks all signs of tracheides below the massive bodies or in the body margins beneath the crinkled prophylls. Comparison of various fields with large arrested buds has shown that the system was formed by a cambium which was in deep-placed tissue beneath the major buds and was extended, right and left, at ever-lessening depth until it joined the phellogen beneath the surface-cork (solid black). The cambium's outer products were layers of parenchyma with sheets and nests of stone-cells throughout their greater depth (solid black) and with a narrow sheet of cork as outer bounding-layer (grey). The cambium's inner products were layers of parenchyma, much deeper than the outer layers, but equal them in number. The depths of inner layers are shown by fine tracheidal strands which have not been connected to form continuous wood (grey). Although bud A was organized with prophylls still united, some prophyll-tips are suberized for more than half their length (Pl. 40, fig. 43, left). Between it and the major group are small arrested meristems in little chambers which are lined by narrow sheets of cork. Bud B is partly covered by thin continuous cork : its narrow, outer prophylls are fully suberized (solid black). The middle prophylls of bud C are partly suberized (fig. 45, right) ; and such small buds as D and E appear to be unaltered (fig. 45).

Some other fields examined have shown that many buds had been invested fully by narrow sheets of cork and that although these fields contained both major buds and meristems, there were no signs of forming shoots throughout their lengths and breadths. I have been told by Holttum of how he has observed that isolated buds and bark and covering sheets of cork are shed like pills from flowering trunks, and have myself confirmed that cork beneath arrested buds

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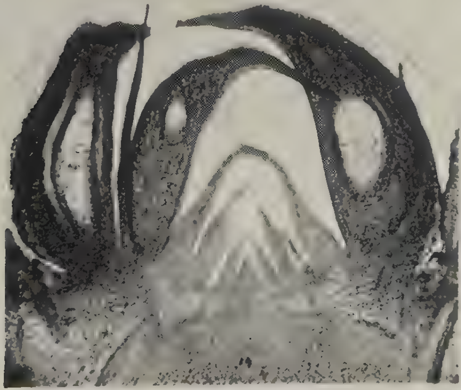
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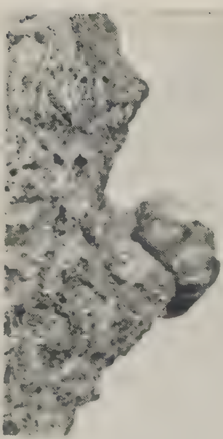

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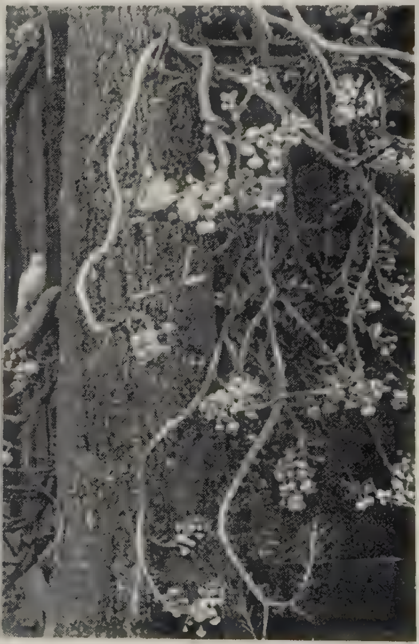

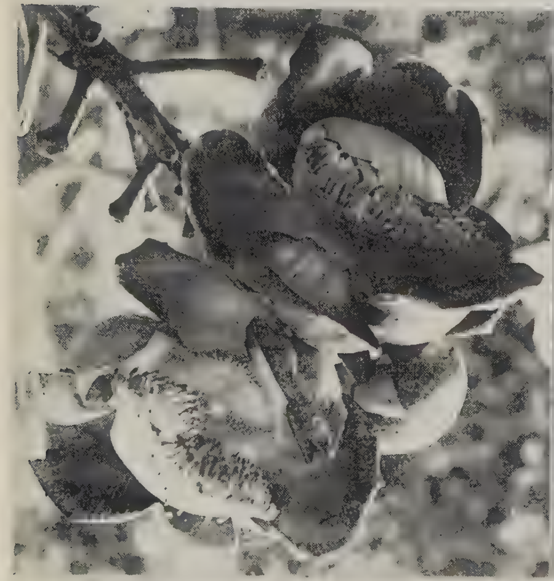

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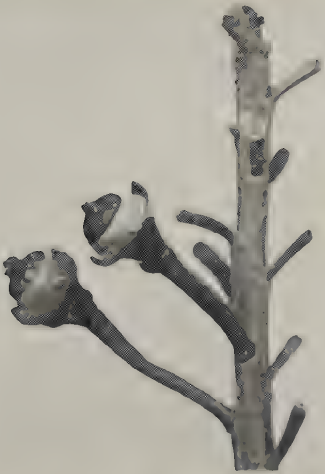

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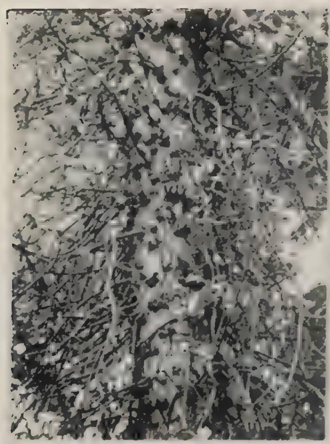

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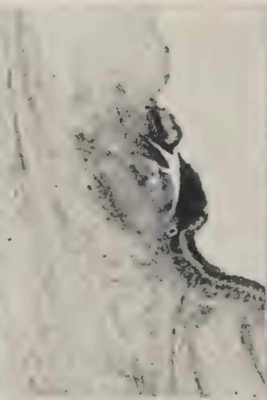

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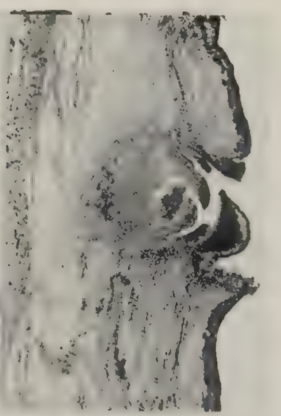

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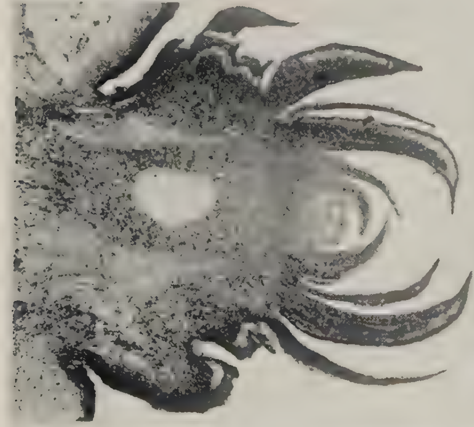

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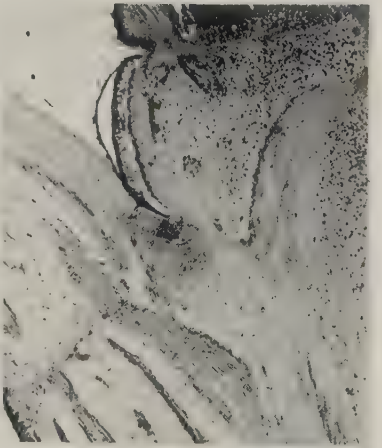

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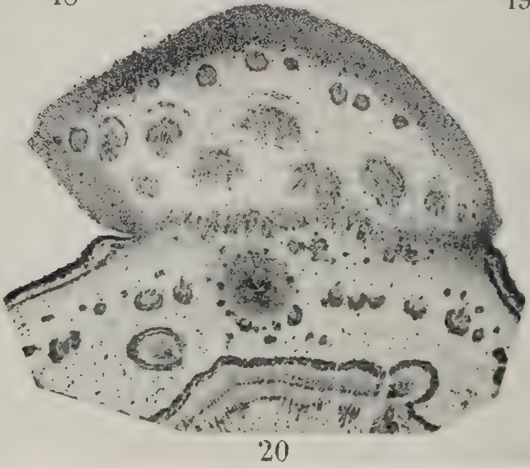

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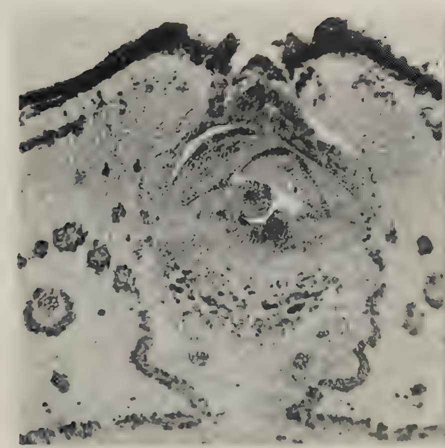
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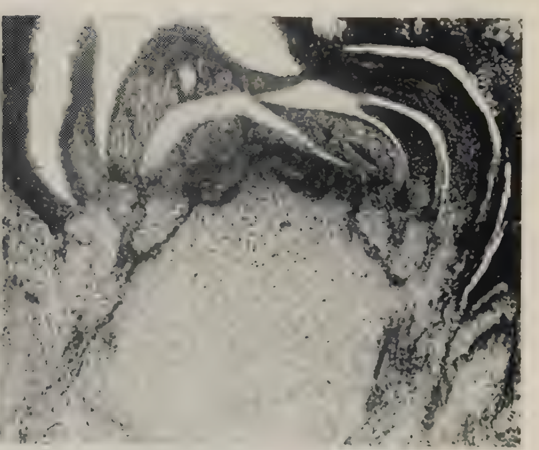
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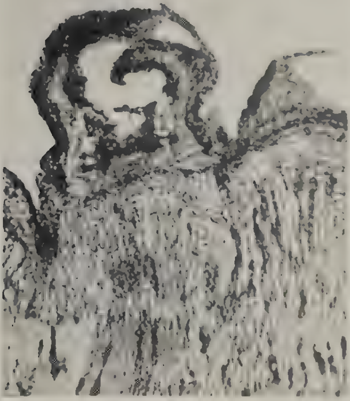
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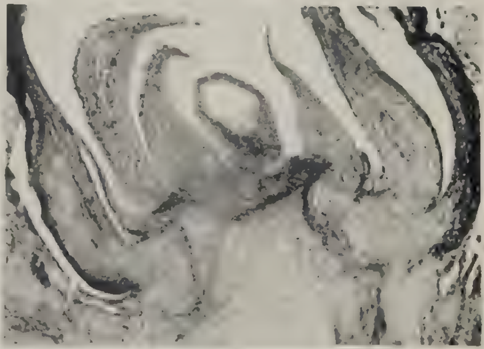
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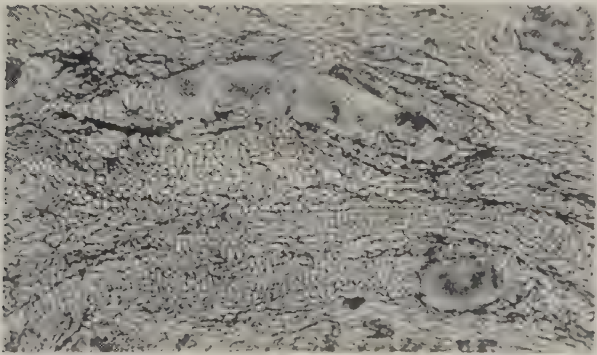
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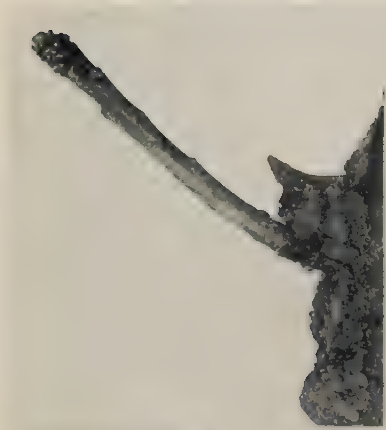

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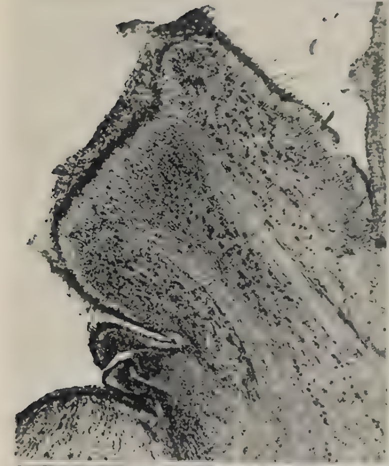

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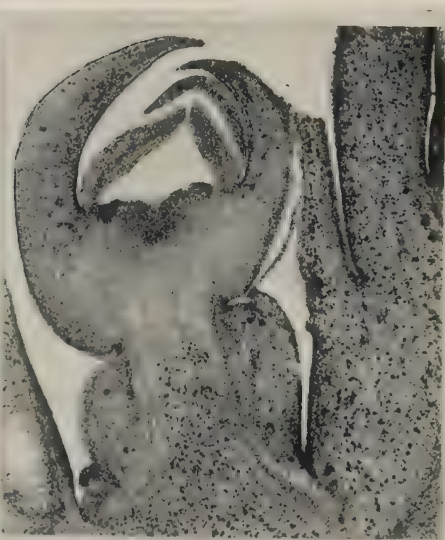

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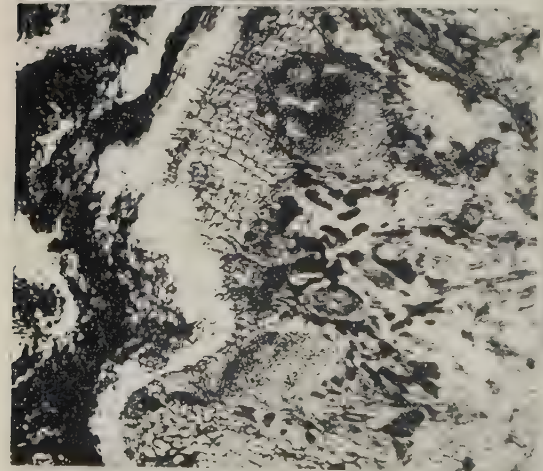

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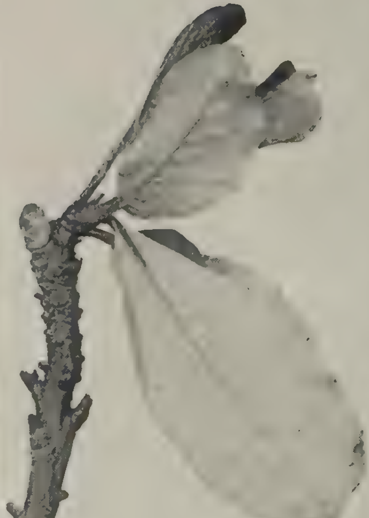

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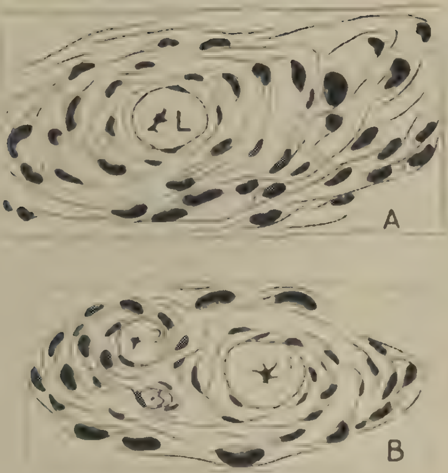

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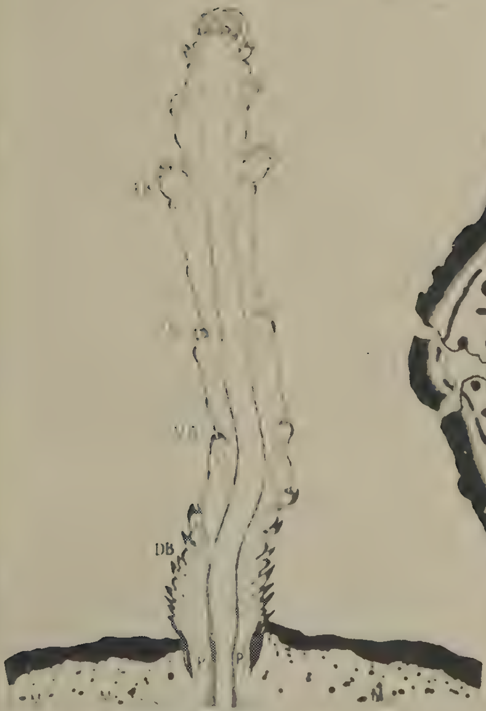

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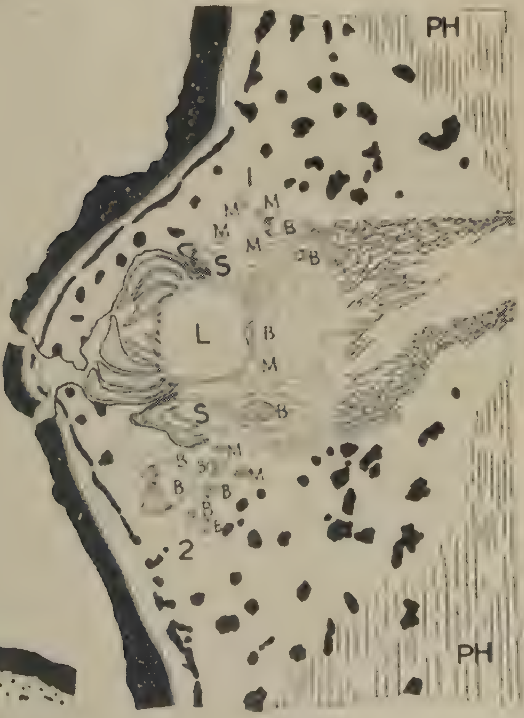

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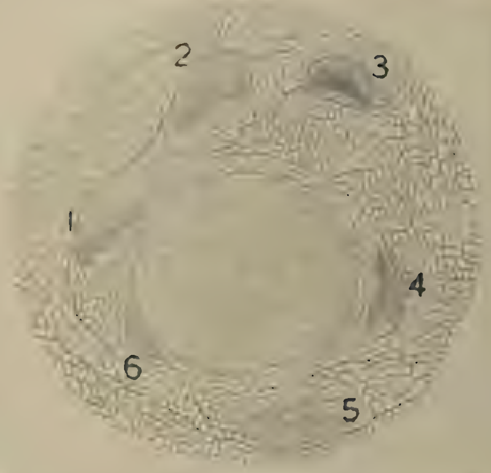

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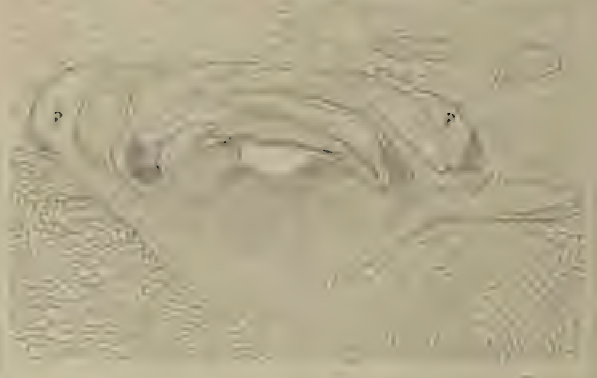

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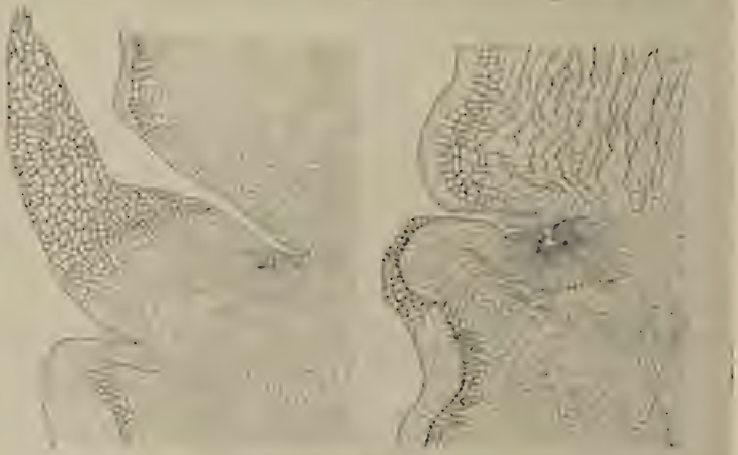

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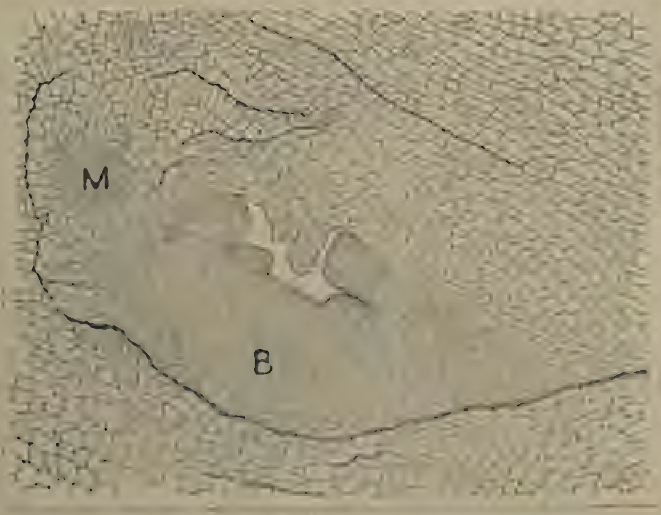

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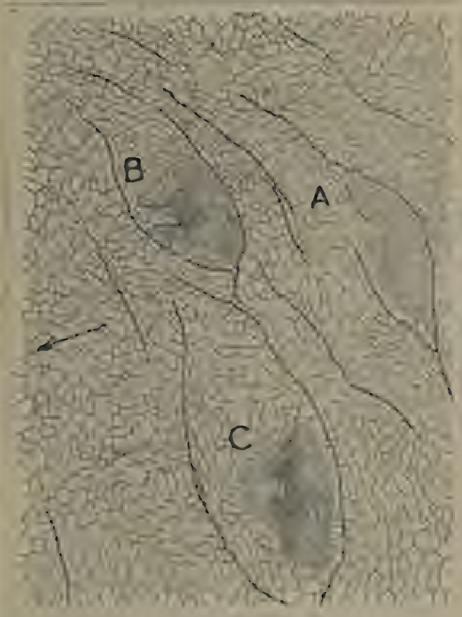

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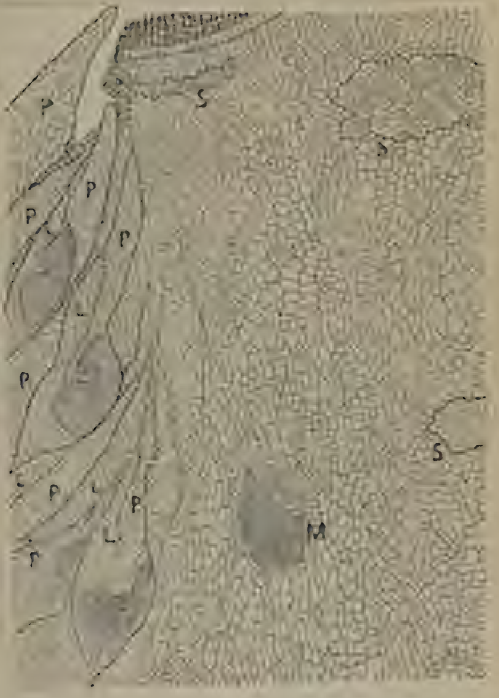

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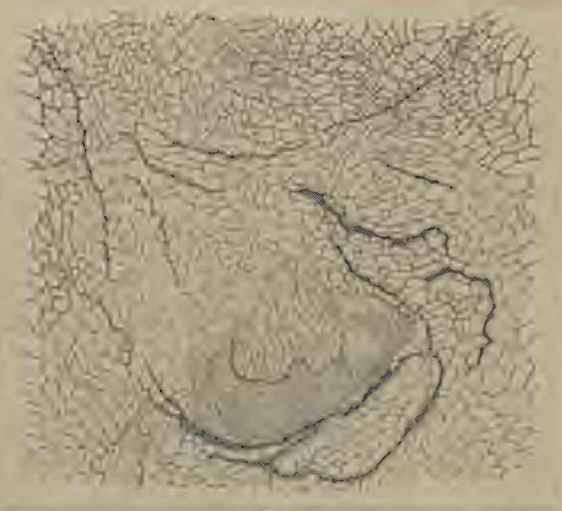

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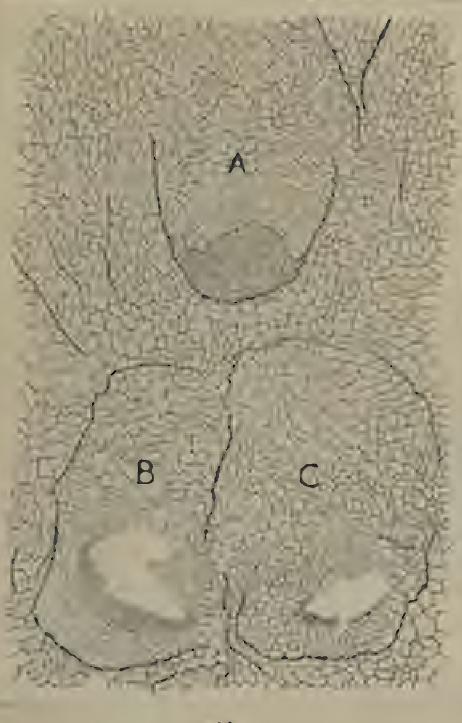

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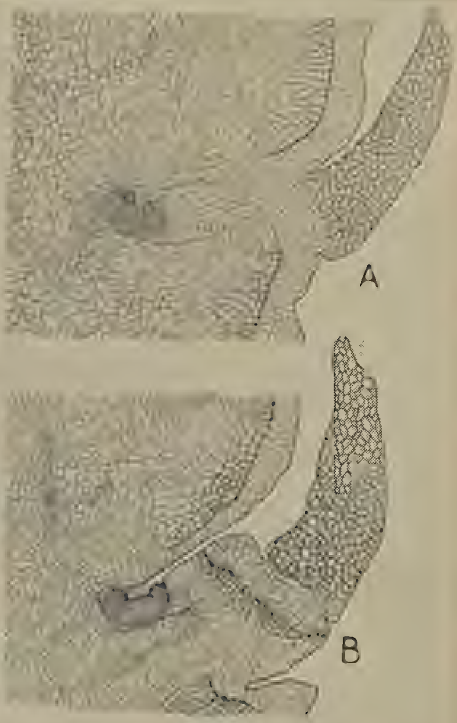

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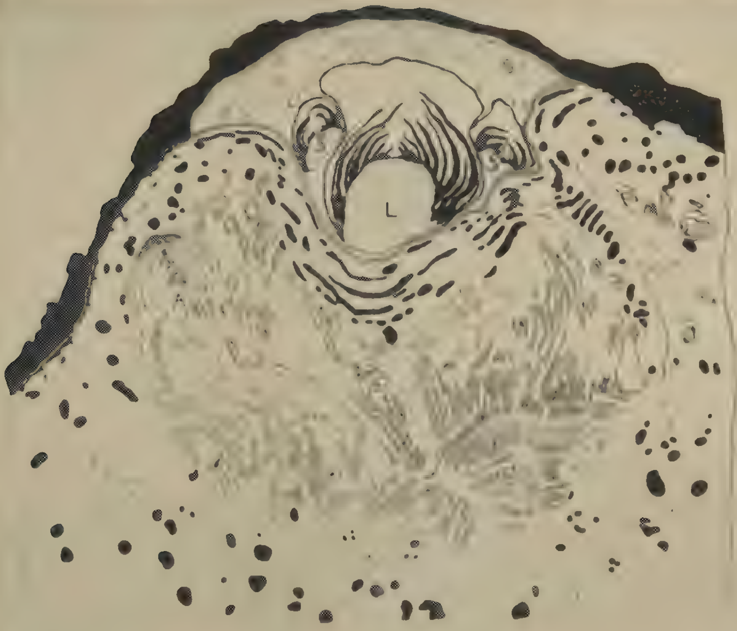

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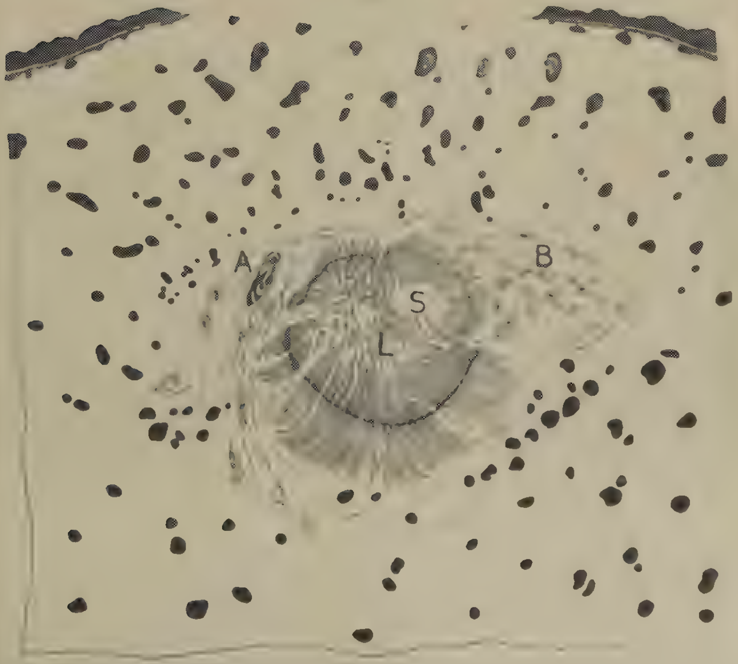

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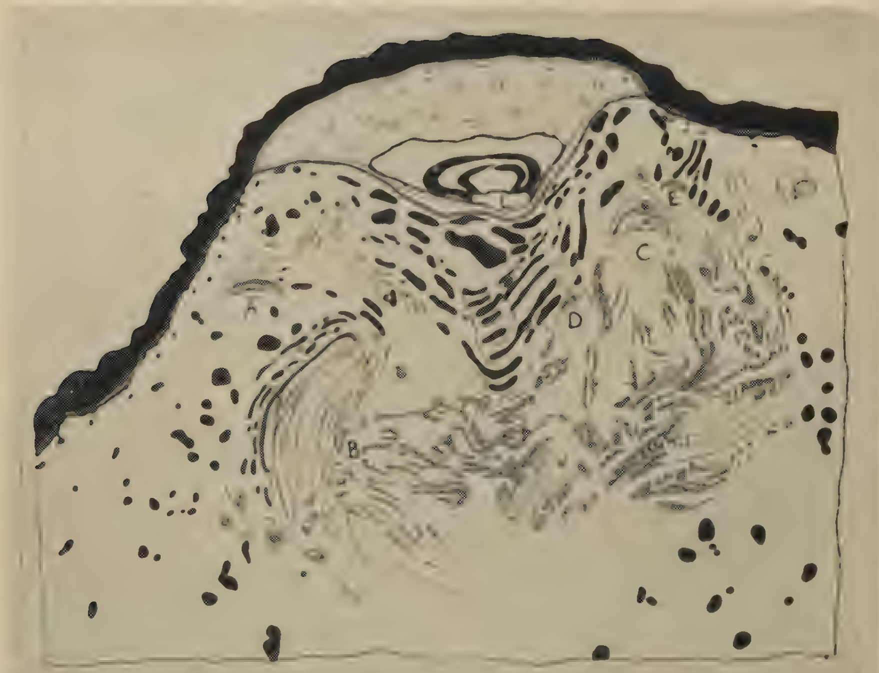

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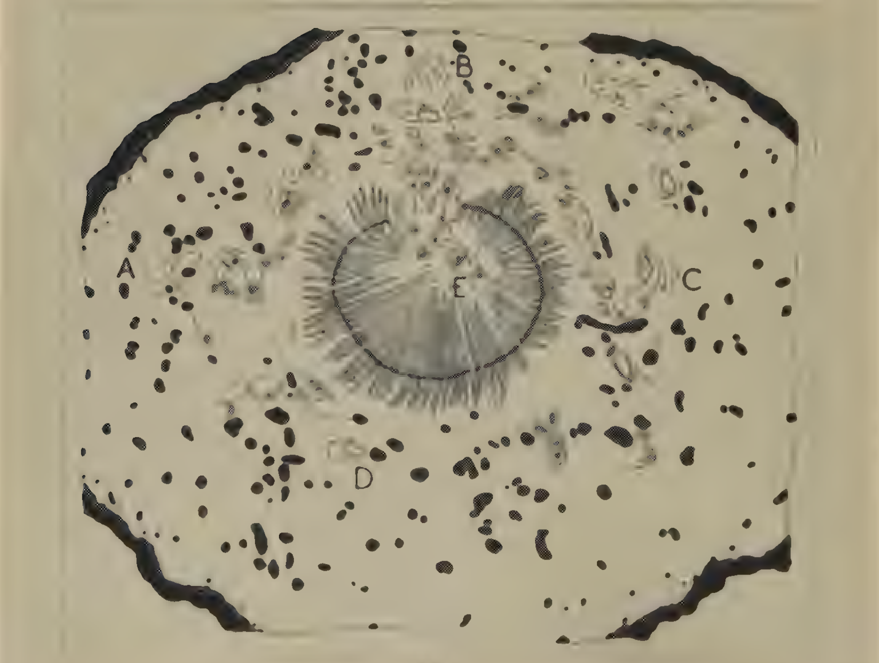

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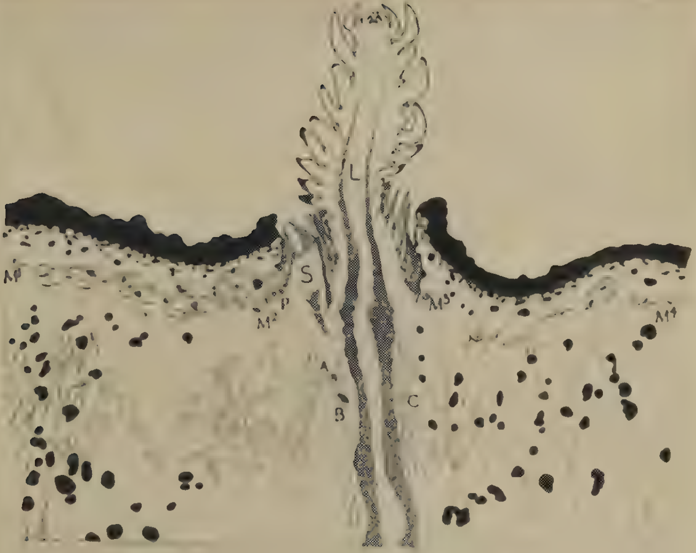

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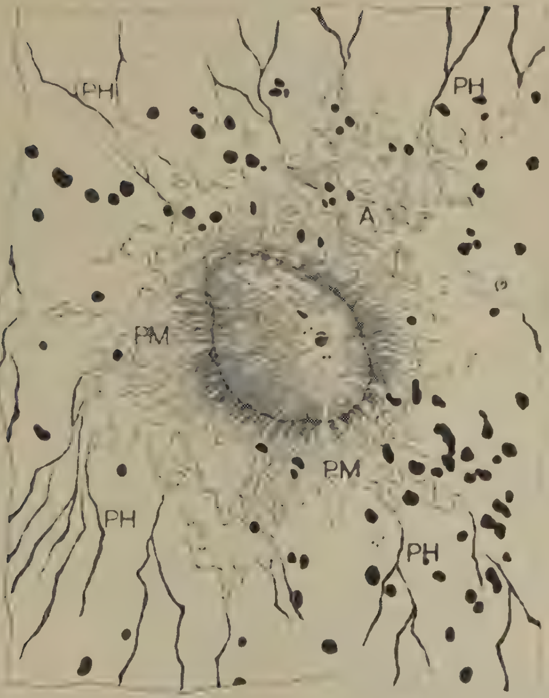

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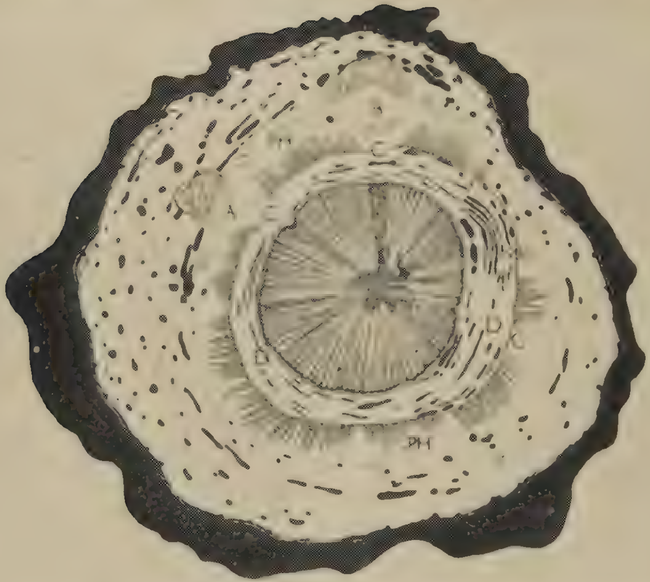

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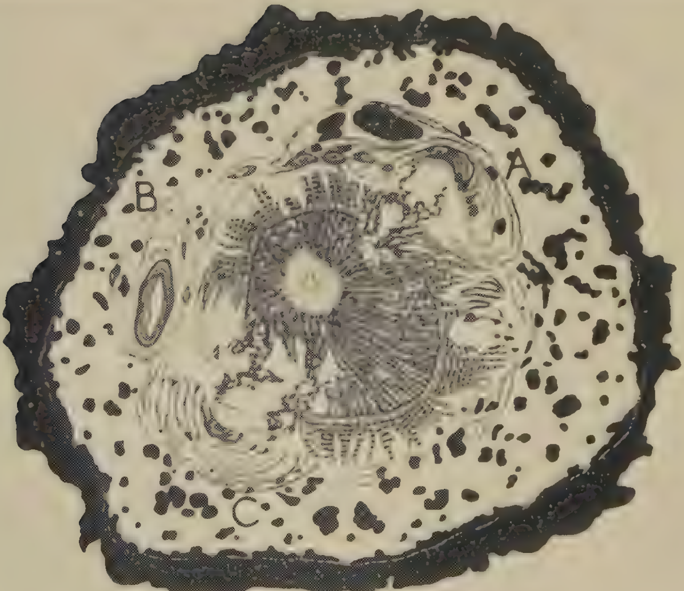

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Couroupita guianensis Aubl.

persists and is undamaged when pill-like masses have been shed and left deep surface-pits. One cannot then assess the buds which living bark contains by flowering shoots which are exposed along the broadened trunks but may conclude, with reason, that they are very numerous, and that arrest is common in many larger fields.

12. *The vasculation of flowering shoots : and new fields.*

In contrast, groups of flowering shoots are formed from many fields and are developed, commonly, with near equality. Their vascular links are broadened before they start to flower; and meristems are organized in new and deeper planes around the links and, often, within their tender cores (Pl. 41, fig. 46). This figure shows a broadened link as crossed in middle length, with independent meristems in little bounded fields within surrounding tissue which A–D defines. Some independent meristems are in the narrow core (E) : a few are in a stelar ' gap ' of thin-walled parenchyma. The links of neighbouring flowering shoots which have been formed together converge and are concurrent in lower middle lengths (Pl. 40, fig. 44, L, S). There may be many meristems beneath their junction-levels (B) ; and compound buds are common outside the sheets of phloem (A). Such buds as are reduced to plans in fig. 31 (Pl. 36) are often round the inmost and broadest length of link. Strong flowering shoots are formed from them despite their deep positions. Since dual or triple growing-points are common in these buds and any one may grow to dominance and thrust the rest aside, it might be thought that flowering shoots have sometimes lower branches, with bases in the broadened pits from which the strong shoots rise (viz. Pl. 36, fig. 32).

13. *Progressive flowering : and the loss of branches.*

It has been noted that a young tree sheds its lowest, drooping branches before some flowering shoots are first observed extending from its bole (Pl. 31, fig. 6). When Holttum made this photograph, he had good cause to think the tree was little more than fourteen years of age, and called to mind its recent loss of several lower branches and how small scaly ' buds ' appeared through fractures in the cork (Pl. 31, figs. 7, 8). There are two obvious branch-scars upon the upper bole, resembling massive lenticels with broadened, upraised margins. The smallest shoots, which will be seen in mainly profile-views, project from little domes : a lengthening shoot is evident upon the middle bole. These and less obvious little shoots were harbingers of many which, later, drew attention as grouped or scattered widely between the levels three feet and nine feet from the ground. The ends of leafy branches at slightly higher levels are drooping, to the left, around the upper bole.

A photograph by Asprey (Pl. 31, fig. 9) shows well how flowering shoots are branched and twisted when they lengthen and straggle round the bole. They lengthen intermittently by major increments : the flowers are always clustered around their apices. Expanded and expanding flowers are shown in fig. 10 (Pl. 31) and serve to indicate, at least, the fleshy perianth, both large and tiny stamens in independent groups, and how the little stamens invest the truncate style (2, 3). When fruits are forming locally near tips of lengthened shoots, the pedicels of flowers which fail persist as cork-sealed stumps (Pl. 31, fig. 9, and Pl. 32, fig. 11). Maturing fruits do not prevent still further growth in length ; but as this growth continues, new flowers are rather scarce : and when the branch-tips reach the ground, they may be mainly foliar. The full-grown fruits are very large and often perfect spheres (Pl. 32, fig. 12) : they seldom fall directly ; but when they have been shed, the pericarps are rotted before the seeds are freed. Old flowering shoots are flexible despite their woody state ; unlike the leafy branches which leave their cork-clad scars, they always fracture near the base and leave broad, jagged stumps.

When many flowering shoots have formed upon the upright bole, still further drooping branches are shed at higher levels (Pl. 32, fig. 13, photographed by Holttum). A lengthy forking branch, to right, droops steeply as it falls : a basal length of lower branch had barred its downward progress. Two recent, narrow branch-scars are fairly evident : one is quite near the basal length which stopped the falling branch : the other is three-quarter inch above the figure-number. There is no strict succession in casting-off of branches so that a few are still to fall when new-formed shoots appear above some recent branch-scars or at new points between them (Pl. 32, fig. 14, photographed by Holttum). The domes which carried flowering shoots at levels on the bole have meantime grown to massive burrs, if compound buds are in them. These buds yield many flowering shoots in groups upon the burrs : and thus, as flowering levels rise, the bole may flower repeatedly. A lower length of middle-trunk which has been flowering often has, in its turn, a great display of ugly, massive burrs, with straggling, thickened flowering shoots or stumps upon their tips or grouped in various numbers upon their roughened sides (Pl. 33, fig. 15, photographed by Holttum). These burrs are also sources of further flowering shoots which may be formed or forming through many years of growth.

14. *Flowering from the stumps.*

The ragged stumps of flowering shoots arouse peculiar interest not only since new shoots arise within their living bark (Pl. 35, fig. 26) but also by the absence of independent meristems. The dead and living tissues are fully isolated (Pl. 43, fig. 49). The dead soft tissues dry and form a sunken, stony rim. The fractured wood is shrunken along its outer length. The cambium is active before the wood has shrunk in forming broadening inner layers of large-celled parenchyma containing nests and parallel sheets of stony sclerenchyma (Pl. 43, fig. 49, D, solid black). The inmost layer, at least, matures as thin continuous cork which isolates completely the mass of shrunken wood (Pl. 43, fig. 49, grey). The cambium (C) remains in place beneath undamaged bast (PH) and plays an active later part in adding tissue to it. When rim and wood have shrunken, large compound buds are formed in many of the ray-mouths, not far beneath the fracture (Pl. 43, fig. 49, A, B). The ray-mouths are like minor fields at many points on trunks in that no other tissue supplies new flowering shoots. There is a level on a stump where wood remains unshrunken and has the narrow cambium between it and the bast (Pl. 43, fig. 50). This figure shows the common state at many lower levels, with single, massive compound buds in much-distorted ray-mouths (A and C), or, sometimes, with a pair of buds when mouths are very broad (B and C). Most of these buds form flowering shoots like those upon a trunk ; their vascular links are organized when they have been composed and furnished with tracheidal strands which join the woody core (Pl. 43, fig. 50).

15. *Minor points of evidence.*

Some minor points of evidence require a few comments although they merely underline the need of further study.

When flowering shoots have grown long, and increments are few, the scale-leaves of the apical buds subtend two buds in row. The upper buds develop as small imperfect flowers with only narrow, central pits in place of ovaries (Pl. 35, fig. 28, centre). A lower bud remains at rest and is extremely small (Pl. 35, fig. 28, left on pedicel) until the neighbouring flower-head is shrunken and excised above a narrow absciss-layer which seals the pedicel (Pl. 35, fig. 27). The lower bud enlarges then and forms a normal flower or one which is arrested when stamens organize. The pedicel of an imperfect flower is quickly clothed in cork before its hairy skin has shrunk or hair-tips have been broken. A second, basal absciss-layer is formed across the pedicel ; and when the greater length is shed, this layer becomes a phellogen. Its total inner products are radial rows of cells, a few of which are added to outer living bark. Small single buds are organized within this compound tissue (Pl. 35, fig. 29): some are arrested, others freed as normal single flowers.

When increments of lengthy shoots bear few and scattered flowers, and hairy leaves are closely grouped beneath their apical buds, the pedicels are fractured, and ruptured tissue hardens; but stumps persist and shrivel, and have no corky layers (Pl. 35, fig. 30). Some upper lateral buds produce peculiar little spur-shoots which, often, are entirely clothed in white aerated cork and thrust aside the apical buds and all the hairy leaves. When spur-shoots add new current lengths, the cork disintegrates, and displaced apices remain at rest, or grow extremely slowly.

As trees grow old and upper trunks become chief seats of flowering, the boles and lower trunks may bear ephemeral leafy branches which spring from compound buds in stumps of early flowering shoots. These branches lengthen quickly and are most prone to wilt as soon as they extend. Unlike the major branches, they lack abscission-layers. They fracture near their bases and leave persistent stumps.

Conclusion.

It has been found that flowering shoots upon a sturdy limb are not developed till the last of all the drooping branches fall and active flowering is in course along the upper trunk. The leafy twigs within the crown grow like the drooping branches except that they are rather short and, commonly, sympodial. Their lateral buds are single; and those on middle lengths form thin side-branches with close groups of leaves below the apical buds. The branches ending in a group of twigs are sloping or erect and are side-branches of a permanent limb and mainly near its tip. They grow like suckers and become the minor permanent limbs which give the crown a framework in early middle life. I have examined several lengths but have not found a trace of meristems or forming buds within their living bark. There can be then but little doubt that flowering is restricted to trunks and lower limbs, and that all flowering shoots are formed from compound buds in bark.

I think, however, that the flowering course could alter in this tree, if buds in all the ray-mouths remained in independence and were developed equally and led to flowering shoots. These shoots would have no lateral buds or prophylls on their bases: in this respect, they would be like the many flowering shoots which spring from single deep-placed buds in bark of Carob Trees (4, 6). In many ways, the course would be like that in *Theobroma* if superficial buds survived on trunks and major branches and furnished many flowering shoots, at ever-rising levels, and bud-formation in the bark became a late event. Whatever factors fix the age at which a tree first flowers might cause the twigs of young trees to form simple spikes some time before the flowering shoots appear upon the bole, and might keep crowns in constant flower, as in related trees.

The behaviour of some allied trees suggests a great plasticity which still awaits enquiry through young and well-grown trees. *Gustavia superba* flowers first upon its crown and, like *G. angustifolia* and *G. speciosa*, flowers later on its trunk. *G. pulchra* is known to flower along the lower bole, whilst flowers are limited to leafy twigs in *G. superba*. It is confirmed that *Lecythis grandiflora*, *L. zaboucaya* and *Couroupita surinamensis* have only branch-borne flowers, that trunk-borne flowers and terminal flowers are formed through many seasons by *C. odoratissima*, and that *C. peruviana* only flowers on thin maturing twigs, True cauliflory or ramiflory are shown by *Grias*, *Couratari*, *Barringtonia*, *Napoleona*, *Craterantos*, *Lecythopsis* and *Asteranthos* which, like those named above, are Lecythidean plants. They, too, appear to call for new and rather special study, freed from the preconceptions that plants must reproduce through surface-buds, and that ancestral forms must all have blossomed distally throughout their lengthy lives.

The writer wishes to express his thanks to his own University for aid towards the costs of illustration.

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DESCRIPTION OF PLATES 30–43.

The description of the plates is given in the text of the paper.

OBITUARIES

Sir **Sidney Frederic Harmer,** K.B.E., Sc.D., F.R.S., died in Cambridge, on 22 October 1950 at the age of 88. He was the second son of Frederic W. Harmer, merchant and manufacturer, of Norwich, who took a leading part in the affairs of his native city, and was an amateur geologist of distinction. S. F. Harmer inherited his father's high principles and public spirit, and his interest in natural history.

He went to Amersham Hall School, and thence as a Scholar to University College, London. He obtained the London B.Sc. degree at the age of 18, and then went up to King's College, Cambridge, where he had a distinguished career as Exhibitioner, Scholar and Fellow. He was placed in the First Class in both parts of the Natural Sciences Tripos.

As tutor of King's and University lecturer in Zoology he taught advanced students for 22 years. Tributes from his former pupils, some now eminent themselves, tell of the clarity of his teaching which gave ' a balanced and judicial summary of existing knowledge ' of the matter in hand ; of the high standards of ' industry, patience and accuracy in observation, clarity and precision in record ' which he inculcated and himself maintained ; and of the affection he inspired throughout his life by his gentleness, courtesy and kindness.

In 1892 he became Superintendent of the University Museum of Zoology where he re-catalogued the collections with his characteristic care and improved them by the judicious acquisition of many specimens. In 1908 he left Cambridge on his appointment as Keeper of the Department of Zoology in the British Museum (Nat. Hist.), of which he became Director in 1919. He retired in 1927.

During the Cambridge years his chief researches were on the embryology, anatomy and taxonomy of the Polyzoa, and on *Cephalodiscus*. In the course of this work he made two discoveries of general zoological importance. Firstly he recognized and demonstrated the Protochordate affinities of *Cephalodiscus*. Secondly he discovered that the embryos of the Cyclostomatous Polyzoa undergo a process of fission by which one embryo produces numerous larvae. The other papers are of more specialized interest. Each is a model of lucidity and accuracy, illustrated with his own beautiful drawings ; each made a solid advance in thought and knowledge of the problem handled ; and they have not been superseded. His revisions of the British species of *Crisia* and *Tubulipora* are (like his later paper on Cellularine Polyzoa in the Linnean Journal) good examples of his success in recognizing, analysing and applying new taxonomic criteria. His paper 'On the Morphology of the Cheilostomata' is characteristic*. In it he studied the frontal wall, operculum and compensation sac of the Cheilostomata Ascophora. He enumerated succinctly the type of structure he had recognized, commented on the bearing of his results on the classification and on the accordance of his conclusions with the palaeontological evidence, and yet refrained from any precipitate attempt to reclassify the group. It is gradually being recognized that the characters so unassumingly indicated may be of fundamental importance in the reclassification that will have to be made when our knowledge is ripe.

He was joint editor with his Cambridge contemporary, Sir Arthur Shipley, of the Cambridge Natural History. His own contributions on the Hemichordata and the Polyzoa are masterly, and the latter is still the best introduction to the subject.

The Cambridge period saw the beginning of his work on the Polyzoa of the Siboga Expedition and of his interest in whales, which were to form the two main threads of his life's work.

His Siboga work proceeded steadily during his London years and after his retirement as long as his health allowed. The first three volumes were published in 1915, 1926 and 1934, and the descriptions and drawings for the last and largest volume were completed by 1941. Engraving of the plates had started when war intervened, and to Sir Sidney's great anxiety many of the drawings were with printers in Holland throughout the German occupation. Fortunately they remained intact and printing has now been resumed. These reports give not only a full and accurate account of an extremely interesting and almost unknown Polyzoan fauna, but also important revisions of the genera concerned. They are illustrated by numerous exquisite drawings and contain information useful to every worker on the Polyzoa.

His years at the British Museum brought a development of his interest in whales. He published an impressive number of papers of his usual high standard, and his indexes and note-books give evidence of an immense volume of work that did not reach the point of publication. His greatest contribution here was, however, his initiation of the scheme for the recording of whales stranded on our coasts. This scheme has brought a continuing flow of material and information to the Museum. Moreover, through his contacts with people in the whaling industry he was able to acquire for the Museum many skeletons of larger whales which are difficult to obtain and transport. In these ways he enchanced the value of the British Museum collection of Cetacea so that it must now be one of the best, if not the best, in the world.

He further helped to advance the study of marine life in general, and particularly of whales, by his keen and effective interest in the work of the Discovery Committee, of which he was vice-chairman for 18 years. He was also chairman of the Discovery Scientific Sub-Committee from its inception in 1927 until failing health compelled him to retire from active participation in the Committee's work in December 1942. Before the formation of the Discovery Committee in 1924 he was a member of the Interdepartmental Committee on Research and Development in the Dependencies of the Falkland Islands to whose report, published by H.M. Stationery Office in April 1920, he contributed a valuable appendix 'The Present Position of the Southern Whaling Industry'. The later researches on whales conducted by the Discovery Committee, which were eventually to lead to effective international control of Antarctic whaling, were largely carried out on the lines he suggested in this important article.

His wide interests in museum work were shown in many ways, for example, by his initiation of experiments at the British Museum on the fading and decay of museum specimens, and by his long connexion with the Museums Association.

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* Quart. J. Micr. Sci., **46**, 1901, 263–350.

He was President of the Association at its meeting at Norwich in 1904 and was made an honorary member in 1922. He also maintained his early interest in the Norfolk and Norwich Naturalists' Society of which he was President in 1901.

Harmer's industry was prodigious. To every matter, whether it was his own duties and researches or the help that he so readily gave to others, he brought the same conscientious thoroughness, the same 'minute and sedulous care' (to quote the obituary notice in the 'Times'). He has left a great volume of files, indexes and note-books filled, during his taxonomic work, with accurate information, methodically arranged and neatly written (or in the latest volumes typewritten) all with his own hand. These, together with his exceptionally fine library of works on Polyzoa and Whales, he gave to the British Museum (Nat. Hist.) to the great advantage of students of these groups.

Like many other zoologists of his generation, he worked as a young man at the Stazione Zoologica at Naples, and found there the opportunity and stimulus which the Plymouth Laboratory has brought to later generations. He, too, worked at Plymouth, and for many years took an active interest in the affairs of the Marine Biological Association and its laboratories.

His familiarity with the Italian language dated from his youth, and evidently owed much to his stay at Naples. He knew enough of several other languages for his scientific reading, including Swedish which he learned especially that he might read the works of F. A. Smitt. He travelled extensively, was fond of music and was a competent pianist. He was a keen cyclist from the early days of the high-bicycle until quite late in life, and he was always an enthusiastic and very knowledgable gardener. During the first world war he spent many nights on duty as a special constable, chiefly on Charing Cross Bridge ; but he never let this interfere with his work at the Museum the next day.

He was a Fellow of the Linnean Society for 31 years, served on the Council, 1921–24 and 1927–32, was a Vice-President, 1931–32, and President from 1927–31. In 1934 he received the Linnean Medal. He was innately punctilious, and many Fellows will remember the blend of affability and formality with which he performed the little ceremony of the admission of Fellows. Two of his Presidential Addresses to this Society, on 'The History of Whaling', and on 'Southern Whaling' (for years 1928 and 1930), constitute a history of whaling which has been described as one of the most useful books of its kind. He devoted his other two Addresses (for the years 1929 and 1931) to the Polyzoa. In them he gave a useful account of the group and a survey of the more significant contents of some recent papers on the living animals, together with observations and comments of his own.

He was elected a Fellow of the Royal Society in 1898, served on the Council and was a Vice-President. Among other honours, he was made a Foreign Member of the Norwegian and Swedish Academies, and an Honorary Member of the Boston Society of Natural History and of the Société Zoologique de France. He was knighted in 1920.

In 1891 he married Laura Russell Howell, his devoted partner for nearly 60 years of happy married life. Those, and they were many, who visited them recall their hospitable home with affection and gratitude. They had two sons and two daughters.

His devotion to Cambridge, and particularly to King's, was deep and lasting. It was a great happiness to him that in 1922 he was made an Honorary Fellow of the College, and that on his retirement to Melbourn, near Cambridge, he was able to be once more in close touch with his College, to dine in Hall, and above all to attend the Chapel services.

I should like to end this notice by acknowledging the ready help of all those to whom I appealed for information about Sir Sidney, particularly mentioning Lady Harmer, whose assistance included a loan of letters, and Mr. Frederic Harmer, C.M.G., who lent me the script of his own account of his father.

ANNA B. HASTINGS.

James Insch (1877–1951). The late James Insch belonged to that large body of naturalists who, while following a business career, have in Britain done so much in the past, directly and indirectly, to foster the study of natural history.

Born in Morayshire in Scotland in 1877, he left school at the age of 15 to work as gardener on the Duke of Gordon's estate at Gordon Castle. While working there and on other estates in Scotland, in Cumberland and in Oxfordshire, he developed an extraordinary interest in botany, especially in its practical applications, and he finally accepted an appointment in the Indian tea industry at the age of 25. He was appointed an assistant on the Ellenbarrie tea estate in the Western Dooars, in the agency of Messrs. Duncan Brothers and Co. of Calcutta, with which firm and its London House he continued in one capacity or another to the end of his life.

I first met James Insch when he was at Ellenbarrie and was struck with his interest in the problems of tea cultivation, which involve questions of plant physiology that hardly occur with any other cultivated crop. The production of the largest number of young leaf shoots possible on each tea plant for the longest period every year and the maintenance of this production for as many years as possible offer problems which fascinated young Insch and he devoted a very keen mind to the solution of the commercial problems which they offer, while serving on and managing a number of other tea estates in the Dooars and Assam.

He did not publish the conclusions that he reached, but he quickly became regarded as an exceptionally successful planter, being appointed visiting agent for Messrs. Duncan Brothers and Co. to many of their tea estates in the Dooars, Assam, Cachar, Sylhet, Darjeeling and the Darjeeling Terai. He was made a partner in the firm to which he was attached in 1921 and remained in Calcutta as senior resident Director till 1932, being the recognized authority on all questions connected with tea cultivation and manufacture.

He left India for England in 1933, becoming a partner in the London firm of Messrs. Walter Duncan and Co., and remained in their London office till 1938 when he retired from active office work. This was not the end of his activities in connection with tea growing, for up to the time of his death he continued to act as adviser to the Duncan group of tea estates, reviewing all tea garden inspection reports with an unrivalled knowledge of tea gardens and of the practical problems connected with them—a knowledge which was continually being enlarged until the date of his death.

Mr. Insch, during the many years of his connection with tea, built up what was perhaps the best private library of works on tea culture in all parts of the world, which he has left to the Linnean Society (of which he was elected a Fellow in 1940), himself providing the funds for suitably binding the works contained in it. Despite his eminence as an authority on tea, Mr. Insch retained a very modest bearing, and it was a refreshment to come into contact with him in his later years and to see the readiness with which he received new ideas on what, with him, had been a life study. HAROLD H. MANN.

Colonel **Austin Edward Armitage**, elected a Fellow in 1948, died in hospital at Victoria, Seychelles, in April 1951.

After serving in the army in India, Colonel Armitage retired to Seychelles, where he and his wife had bought an estate. He had many interests including the study of tropical fish, of which he had a close and intimate knowledge. Wild life preservation also was a subject of keen interest, with constant vigilance for the preservation of the colony's fauna. This interest was of great practical value, particularly in an area such as the Seychelles Archipelago where, owing to deforestation and other causes, many endemic species were in danger of extinction.

He was prominent in public life and, in addition to numerous other duties, he was a member of the Governor's Executive Council. His advice and counsel was at all times both sound and constructive, and ranged over a wide area. As a proprietary planter, he took particular interest in the welfare of his labourers, who lived in model surroundings in keeping with the orderliness of Bel Ombre Estate. He was a pioneer in this respect and the good example set was a source of inspiration to others.

His death at a comparatively early age is a very great loss to the Colony and to the advancement of natural history in that part of the Indian Ocean ; he will be sadly missed by all who knew him. He was buried at sea off the coast of Mahé. J. N. Milsum.

Professor **Frederick Tom Brooks,** C.B.E., M.A., LL.D., F.R.S. By the death of Professor Brooks which took place with unexpected suddenness on the evening of the 11th of March, not only the world of biological science but many institutions, official and otherwise, have lost a great leader and investigator whose sincerity and forthrightness were acknowledged by all who came in contact with him.

The youngest of a family of three girls and two boys, Frederick Tom Brooks was born at Wells, Somerset, on 17 December 1882, and was educated at Sexey's School, Bruton, where he first developed that love of field botany which he never forsook. Destined for the teaching profession from the beginning, he left school at the comparatively early age of 15 to enter a Training College at Bristol where the rigorous methods then in force and the ordeal of facing large classes developed his inherent gifts of lucid exposition and courage which were to play so great a part in the future. In all his examinations at the Training College and subsequently at the University Brooks gained 1st classes.

In 1902 Brooks was awarded an Exhibition at Emmanuel College, Cambridge, and proceeded to read for the Natural Sciences Tripos, making botany, which had so attracted him at school, his main subject. It was not long before he came under the watchful eye of his professor, Marshall Ward, whose chief interest at that time was the investigation of plant diseases, especially those caused by the rust fungi. After gaining 1st Class honours in both parts of the Tripos in 1905, Brooks was appointed junior demonstrator in Botany for the maximum period of five years. In September the following year, Marshall Ward died after a long illness and Brooks was left to carry on the work in mycology at the early age of 24 without the help of the one person who had such faith in him ; a faith fully justified for the next 40 years.

Besides his demonstratorship Brooks had also been awarded the Frank Smart Studentship in Botany which necessitated changing Colleges and he took up residence in St. Michael's Court, Gonville and Caius College, where the present writer as an undergraduate first met him to go over a youthful essay on some mycological subject.

In 1907 Brooks married Emily Broderick and together they set up house in Mawson Road but later migrated to nearby Tenison Avenue. There were no children of the marriage. Towards the end of 1913 Brooks was seconded for a year to investigate a disease of rubber trees in the Federated Malay States which was then causing much concern to the planters. Returning home just before the first German War broke out, Brooks, as a keen patriot and former member of the Cambridge University Rifle Volunteers, endeavoured to enlist, but was not accepted on account of his eyesight. He did, however, render considerable assistance to the national effort by undertaking various technical investigations and when the Food Production Department was established he acted as plant pathologist to that institution. Among other matters this involved a study of the spread of potato blight, an extensive investigation of the moulds developing on chilled meat delayed in transit from overseas, and some exciting work with an organism known as the ' XY bacillus ' which fermented maize meal in the production of acetone then in great demand as a solvent in the manufacture of explosives.

Brooks resumed his University duties in 1919 in which year he was made lecturer. A great deal of extra teaching, apart from mycology and plant pathology, which was involved by the death of R. P. Gregory who lectured on algae and cytology now fell to Brooks who, in characteristic manner, tackled these new duties with earnestness.

For some years he carried out a long and important series of investigations into the silver leaf disease of fruit trees, collaborating in some of them with a few of his former students. The cereal rusts which he had commenced to study under Marshall Ward next received his attention and a lengthy research into the rusts of the brome grasses which was still in progress at the time of his death. A wide range of the fungous diseases of other cultivated plants was also undertaken during these years.

His great reputation as a plant pathologist had attracted a considerable number of research workers who came from all parts to work in his laboratory and to inaugurate new investigations under his stimulating influence.

In 1931 Brooks was elected a Fellow of the Royal Society and was also made a Fellow of his own College, Emmanuel; at about the same time a generous donation from the Rockefeller Foundation enabled the Botany School to expand so that Brooks was able to acquire a Field Station on part of the University Farm on which he planned and erected extensive glasshouses with laboratory facilities. In the same year he was made Reader in Mycology and five years later was elected to the Chair of Botany made vacant by the retirement of Sir Albert Seward. For the next twelve years the Botany School was extremely well administered, Brooks being one of those who loved efficiency and inspired willing co-operation. In 1947 he was made a C.B.E.

Though a little below the average height, Brooks was a keen participant of sport, playing tennis and squash racquets. He was a great walker and could outwalk many a bigger man; swimming he also enjoyed and up to the thirties always took an early morning plunge in the Cam throughout the year, running all the way there and back, a distance of nearly two miles, from his house in Tenison Avenue. At the back of this house was a large garden well stocked with uncommon flowers many of which he had collected and planted himself. He was ever fond of emphasizing the merits of good gardening and on one occasion expressed the opinion that one could not hope to be a botanist unless one was first and foremost a gardener. Brooks also indulged in dancing but was compelled to forego many energetic pursuits following a serious operation in 1940.

His many and varied activities were only made possible by the possession of an extremely orderly mind: he had a set time for most things though the routine was by no means inflexible. There were recognized times for laboratory work, correspondence and interviews in which he was ever ready to discuss difficulties with students or colleagues who profited much by his candid and sincere advice. His correspondence was enormous and increased rather than diminished as time went on, for he was very closely associated with several government institutions, being Chairman of a Committee of the Agricultural Research Council, a member of the Forrestry Commission and of several governing bodies. In the midst of all he still carried on his research and completed writing the new edition of his book, *Plant Diseases* (now in press).

His lectures, both public and university, were most carefully prepared and the courses on mycology and plant pathology were so stimulating, that many on attending them soon decided to continue in these subjects and make them their lifes' work. Thus, during the 40 years Brooks had charge of the teaching of his chosen subject nearly one hundred trained mycologists and plant pathologists obtained posts in various parts of the world.

Possessed of great energy, transparent honesty and a will of iron, Brooks was greatly respected by all who came to know him and perhaps a little feared by the younger generation, for he did not suffer fools gladly and invariably expressed himself in no uncertain terms ; but he was never resentful and was always fair. He had a great sense of humour, and many will miss, but always remember his loud and hearty laugh.

Brooks was elected a Fellow of the Linnean Society in 1922, serving on the Council from 1941–44, and as Vice-President 1943–44.

W. J. Dowson.

Professor **Emile Topsent** * was born at Havre on 10 February 1862, and died at Dijon 22 September 1951. He began the study of natural sciences in the University of Caen, under Delage, who at that time had only two other students of natural history, P. A. Dangeard, the botanist and A. Bigot, the geologist. Even as a student he was a frequent visitor to marine laboratories and came under the influence of many other distinguished French zoologists and especially Lacaze-Duthiers.

He was appointed to the School of Medicine and Pharmacy at Rheims in 1889, in charge of the natural history department which included botany. From 1896 to 1904 he held a similar post at Rennes, after which he joined the staff of the Zoology Department at Caen University. In 1910 he was appointed Professor of Zoology and Physiology at the University of Dijon, and in 1915 also Director of the Natural History Museum at Dijon. On the opening of the French University in Strasbourg in 1919 he became their Professor of Zoology, and from 1921 to 1927 was Director of the Zoological Institute and Museum in Strasbourg. He was elected an Associate of the National Museum of Natural History in 1927 and after his retirement in 1932 was appointed honorary professor of the Faculty of Science in the Universities of both Dijon and Strasbourg.

In addition to his official duties Topsent took part in many other activities. Whilst at Caen he directed the Marine Laboratory at Luc-sur-Mer. He was also in charge of the Town Museum, and took an active interest in the Linnean Society of Normandy, his first publications (from 1885 to 1888) appearing in the journal of that Society. At Dijon his attempts to found a station for the study of fresh-water biology were successful, and the Station Grimaldi was opened at Saint-Jean-de-Losne in 1912 largely through grants obtained from Prince Albert I of Monaco.

Topsent was very fond of Dijon and returned there after his retirement from Strasbourg in 1932. He then occupied himself with the Zoological Museums both in the University and the Town.

Topsent was a voluminous writer and more than 190 publications appeared under his name including various large volumes of the Prince of Monaco's *Campagnes Scientifiques.*

His work dealt mainly with the classification of sponges but he also published articles on many other groups ranging from Protozoa to insects and even fossil vertebrates. He elucidated the life cycle of a species of *Adoxus*, a Chrysomelid beetle which reproduces parthenogenetically and was formerly a serious pest of vines. He also published an account of the interesting dipteron, *Ptychoptera albinana.*

Sponges, however, always remained his chief interest and he will be remembered mainly for his work on that group. His doctor's thesis and various memoirs were devoted to the Clionidae. He worked out the sponge collections of *l'Hirondelle* and of the *Princesse Alice*, and numerous other collections from the Azores, Canary Islands, Senegal, Algeria, the Seychelles, Red Sea, Amboina, etc. and those of four Antarctic expeditions. He had an unrivalled knowledge of the French species and published chapters on the Tetractinellidae, Carnosa and Hadromerinae in *La Faune de France*. Unfortunately this monograph was not completed. He took great interest in the Mediterranean sponges and several times worked at the marine stations of Naples, Sete, Banyuls and especially Monaco. Apart from his outstanding taxonomic studies he threw light on many aspects of the morphology, histology and life histories of sponges.

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* The writer is indebted to Professor J. R. Denis, University of Dijon, for valuable assistance in obtaining the necessary information.

Topsent was awarded various honours and decorations for his scientific contributions, including the Prix Cuvier in 1929 and the Prix Lasserre in 1933. He was elected a Foreign Member of the Linnean Society in 1932.

EDWARD HINDLE.

Stephen King Montgomery, who died at Cape Town on 20 January 1950, was a member of the South African Chapter of the American College of Chest Physicians and this obituary is based on that which appeared in *Diseases of the Chest*, No. 4, **17**, 489, April 1950.

Born in Tasmania in 1895, he soon moved with his family to New Zealand, from whence, during his early boyhood, they returned to Perth in Western Australia, where he graduated B.A. with honours. After military service in the First Great War, he resumed his studies, taking B.Sc. with honours in Zoology. For his medical studies he proceeded to London, graduating M.B., B.S. in 1926. Resident posts at University College Hospital, the Hospitals for Tropical Diseases in London and Newcastle, and the British Hospital, Port Said, followed, and on his return to London he took his M.D. Choosing radiology as his special subject, he went to Edinburgh and obtained the Diploma in Radiology, with high distinction, in 1930. After a short spell of radiological practice in London, he settled in South Africa, first in Johannesburg and then in Cape Town. As a diagnostic radiologist he held a high place amongst his contemporaries and the University of Cape Town appointed him examiner for its Diploma in Radiology.

He was a frequent contributor to Medical Journals and an active member of the Medical Association of South Africa. During the Second Great War he organized and led a Radiological Unit ; later he was Honorary Secretary of a large branch of the Ex-service Medical Officers' Society until failing health compelled him to relinquish practice in 1948. Dr. Montgomery had wide interests outside his professional work. He was elected a Fellow of the Linnean Society in 1925 and published several papers on crabs, the most important of which, a Report on the Brachyura of the Percy Sladen Trust Expedition to the Abrolhos Islands, appeared in the Society's Journal (Zoology) in 1931. For his leisure hours he had planned a study of the Diatoms of the False Bay Coast. He was fond of good music and a lover of poetry, deeply religious and very reserved and modest in his social contacts, yet withal a loyal friend and a fearless fighter against injustice in any form. He is survived by a widow, a son and a daughter.

John Gossweiler, who died in Lisbon on 19 February last, had been a Foreign Member of the Society since 1950, when he was elected in recognition of his signal services to African botany over a period of fifty years.

He was born on 24 December 1873, at Regensdorf, Zürich, where his father, Hans Gossweiler, owned a business. After preliminary studies in horticulture in Zürich, he continued his education at the Institute of Horticulture in Stuttgart and afterwards in Dresden. These early years in Germany were not entirely happy ones and at about the age of twenty-three he came to London where he spent four years of scientific study, two at the Royal College of Science, South Kensington, and two at the Royal Botanic Gardens, Kew. At the latter institution he received an inspiration which coloured his whole life. Of Thiselton-Dyer, who was then Director of Kew, he always spoke with great respect, quoting him as a model of order and punctiliousness. During this period he learned to speak English with considerable fluency and used it for preference in his scientific works, though these took their final form in Portuguese. His field-notes, of which the originals were in English, especially during his earlier years, have an exuberance of style which give them a character all their own.

Towards the end of last century, the Government of Angola decided to establish a Garden of Acclimatization and Gossweiler was appointed for this work in 1899, when he left Europe for Luanda, where he made his home for more than half a century, though with numerous absences on his many excursions. Owing to administrative delays in starting the garden, he was able to devote much time during his first few years in Africa to beginning the collections that were to make his name famous in the great herbaria.

At that time our knowledge of the flora of Angola was mainly due to the work of Welwitsch during the middle of the 19th century, who collected principally in four regions : the coastal area of Luanda ; the Cazengo forest and the adjoining strange and interesting region of Pungo Andongo ; the desert of Mossamedes ; and the Huilla Plateau. Apart from comparatively small collections made on Alexander von Mechow's Expedition and some specimens collected by Sisenando Marques, Pogge and Büttner in Malange and Lunda, the interior of the colony from Malange eastwards was botanically unexplored, while further south the region of Bié and the country to the east of the Chela Mountains were quite unknown.

Gossweiler's first specimens, which were sent to Europe in 1900, were from the littoral region of Luanda but he was soon able to follow in Welwitsch's footsteps in the Cazengo forest and Malange, where he re-collected many of the Welwitsch species and found a number of novelties. Meanwhile, in 1899–1900, Baum was exploring the Rivers Cunene and Cubango in the far south. Five years later, in 1905, Gossweiler was sent to the Ganguelas region (Bié) to study native rubber-producing plants and, with his base at the old Forte Princeza Amelia (now Vila da Ponte), on the River Cubango, he collected over an extensive and quite unknown region which linked up, in the south, with the area covered by Baum. In this Bié region there are large areas of ' chanas ', small shrubs and low grass, burned every dry season by bush-fires and characterized by the peculiar species so often described by Gossweiler as ' polycephalous, rhizomatous undershrubs '. In these ' chanas ' and in the ' tengas ' or marshes along the river-valleys, he discovered a host of new species.

In 1907 work on the garden was at last begun. It was called the Cazengo Colonial Garden and the site chosen was the old, abandoned plantation known as the Granja de S. Luis. Here Gossweiler introduced many exotic species from tropical Asia and tropical America. During this period he made such a thorough exploration of the Cazengo rain-forest that it is now one of the best known areas, botanically, in tropical Africa.

It is impossible to recount in detail all Gossweiler's numerous collecting trips in Angola and I must confine myself to those which gave the most important botanical results. Beyond doubt the most fruitful of all were his three or four visits to the great Mayumbe rain-forest in the Cabinda Enclave. Almost all that we know of this forest, as regards the part of it which lies in Portuguese territory, is due to Gossweiler's efforts. At various times he visited Subluali, Pango Munga, Caio and Belize, and camped with his wife, for many months, in an isolated region near the source of the River Zanza. The resulting collections were rich in new species.

From 1919–1926 he left the government service and worked privately for Fomento Geral de Angola. During these years he collected along the southern bank of the Congo, at Quissama, in the Dembos region and along the River Bengo.

He re-entered the service of the Angolan Government in 1927 and was charged with the organization of an Experimental Cotton Station at Catete.

In 1932 he was sent to investigate diseases of coffee in Amboim and had his first opportunity thoroughly to explore the mist-forest in the neighbourhood of Gabela and Capir (Cuanza Sul). The collections he made established the fact of a great southerly extension of the rain-forest flora, which here reaches its southern limit in West Africa.

In 1938 he accompanied the late Professor Carrisso's Botanical Mission and his vast experience of the country greatly contributed to the success of this expedition, marred though it was by the death of its leader in the Mossamedes desert. Gossweiler, accompanied by my wife and myself, organized the return journey from Sá de Bandeira by road to Luanda with the Mission's large collections and he afterwards went with us on further collecting trips to Cazengo and Amboim.

His last important collection was made in 1947, when he was seventy-four years old, in the gallery-forests at Dundo, in the extreme north-east of the colony, on the frontier of the Belgian Congo. This added many new species to the Angolan flora and showed interesting links with the flora of the Mayumbe forest in Cabinda.

Owing to its long connection with Angola, dating from the time of Welwitsch, it was natural that the Botany Department of the British Museum should take a special interest in the Gossweiler collections and for many years several members of its staff were regularly engaged in publishing the identifications and descriptions of his plants in the *Journal of Botany*. He sent the first set of most of his collections to the British Museum and the Portuguese generously allowed him to distribute his duplicates to many European and American herbaria. His name is commemorated by the genera *Gossweilera* (Compositae) and *Gossweilerodendron* (Leguminosae) as well as by numerous specific epithets.

Although it is to his collections, amounting in all to over 14,000 numbers, that Gossweiler will owe an enduring fame, he was also the author of a number of papers on Angolan plants of economic importance and of two major works, the *Carta Fitogeográfica de Angola* (1939), written in collaboration with F. A. Mendonça, and the *Flora Exótica de Angola* (1949–50). The *Carta Fitogeográfica* contains the fruits of his observations made during his many journeys throughout the length and breadth of Angola and is, in spite of some details which may need correction, a work of great value to the phytogeographer and ecologist.

John Gossweiler was small, thin and wiry, and must have had an excellent constitution ; for fifty years' collecting in tropical Africa is probably a record unequalled by any other botanical collector in such a climate. He was full of energy and untiring in the field in his search for new and interesting plants. He had been so long isolated from the main centres of botancal study that his ideas seemed sometimes a little strange, and as he held to them with great obstinacy and determination, fierce arguments with his Portuguese companions often developed.

My wife and I, who travelled for thousands of miles with him, owed much to his courage and kindness in times of difficulty and adversity and felt for him the affection and respect due to a kindly man of great integrity of character.

John Gossweiler and his charming Swiss wife, Marthe Gossweiler, who survives him, were much loved in Luanda, where he will be greatly missed. They have one daughter, Ruth, who is married in Switzerland.

He has left us not only affectionate memories but also a great task. There is still a lifetime's work to be done in classifying the material he collected.

John Gossweiler was a Fellow of the Society from 1905–1937.

A. W. Exell.

John McConnell Black author of *The Flora of South Australia*, died at his home in Adelaide on 2 December 1951, in his ninety-seventh year. At the time of his death he was engaged in the revision of his *Flora*. The Second Edition of Part I had appeared in 1943 and of Part II in 1948; it had been decided that Part III of the revision should end with Plumbaginaceae and not as previously with the Scrophulariaceae. Black had practically completed the text of this family on the evening before his death and had left open on his table the botanical works that he had then been consulting. Part III will have been published by the Government Printer, Adelaide, before this notice appears. Black's additions, notes and corrections for Part IV are so complete that the Handbooks Committee of the South Australian Branch of the British Science Guild has arranged for the final part to be prepared for the press forthwith. In spite of his great age, his mind had remained alert and critical up to the last.

J. M. Black was born at Wigtown in Scotland on 28 April 1855, the son of George C. Black, Procurator-Fiscal. He was educated at the Grammar School in his native town, at the Edinburgh Academy, at Taunton College School and finally at the Dresdener Handels-Schule in Germany. He spent a short while with the British Linen Company's Bank in Edinburgh and then with the Oriental Bank in London. In 1877 he came to South Australia, and after an experience of five years of farming in a rather dry portion of that State, turned to journalism and also became a Hansard reporter. For the rest of his life his home was in Adelaide. In 1902 a legacy from his sister enabled him to retire at the age of 47, and to devote himself to the studies that particularly appealed to him. In South Australia he found to his hand an open field for the study of its plants and, being an accomplished linguist, the opportunity to record aboriginal languages. His first publication as an amateur botanist was *The Naturalised Flora of South Australia* which appeared in 1909 and was well illustrated with his own drawings. In the same year he contributed to the *Transactions of the Royal Society of South Australia* (Volume 33) the first of a series of papers, later entitled ' Additions to the Flora of South Australia ', which ended with No. 45 in 1949 (Volume 73). These *Transactions* were the vehicle for his more important contributions, botanical and linguistic. They contain several other papers of his besides the ' Additions ', some dealing with the botanical results of scientific expeditions into the interior of the continent.

In 1920 the South Australian Branch of the British Science Guild—the Guild itself is now merged in the British Association for the Advancement of Science—approached the Premier of the day, Sir Henry Barwell, with a proposal for a series of handbooks on the fauna and flora of the state. These were to be prepared by specialists working in an honorary capacity and presented as a gift to the State if the Government were prepared to publish them. The Premier described this as ' a very generous offer ', it was approved by Cabinet, and J. M. Black was asked if he would undertake the preparation of the first Handbook, *A Flora of South Australia*. Part I of this *Flora* appeared in 1922, the first of a long series of works dealing with the plants and animals of that State. Part IV was completed in 1929.

In South Australia many new plants awaited recognition though Black's predecessors, Robert Brown, Baron Ferdinand von Mueller, Professor Ralph Tate and Dr. R. S. Rogers, aided by the ardent collector J. G. O. Tepper and the collections made on expeditions of exploration, had recorded or described a majority of the native plants. Moreover, alien plants were establishing themselves in ever-increasing numbers and replacing to a great extent the indigenous ones in settled areas. Not only did distant parts of the dry interior—the sandhills of Ooldea on the East-West Line, the mulga and the saltbush plains, the rugged mountains of the Far North-West, the *Triodia*-covered hills and the sandy beds of watercourses—yield new species of vascular plants but several were discovered by his collectors in the Encounter Bay district, and one, a very distinct species of *Lomandra* (*L. densiflora*—Liliaceae), on the foothills near Adelaide and even within the bounds of that capital city. This *Lomandra* had escaped recognition as its flowers were hidden at the base of stiff grasslike leaves and appeared unduly early in spring. Black described seven genera as new—*Pectinella*, 1913, later sunk in *Cymodocea* (Potamogetonaceae); *Griffithia*, 1913, later included in *Helipterum* (Compositae); *Uldinia*, 1922 (Umbelliferae); *Hymenocapsa*, 1925, now sunk in *Gilesia*, or *Hermannia* (Sterculiaceae); *Embadium*, 1932 (Boraginaceae); *Clelandia*, 1932 (Violaceae); and *Sarcozona*, 1934 (Aizoaceae). He also described approximately 178 new species and 40 new varieties and effected a number of new combinations. Amongst his more interesting or important species are *Uldinia mercurialis* and the tall handsome *Nicotiana excelsior* used by the natives from time immemorial for chewing. His herbarium was bequeathed to the University of Adelaide.

Black was remarkably thorough in all his work. He could never rest till a problem had been solved. When new specimens were received notes and excellent drawings were appended to the herbarium sheet. At the same time he made marginal notes in the working copy of his *Flora*, adding to or modifying descriptions previously made as might be necessary. Thus, when the time for revision came, much of the work was already done, ready for review. With meticulous care the manuscript was then prepared for the printer. Nearly all his work was done at his home.

In 1930, Black attended the Fifth International Botanical Congress in Cambridge. It was then that he became an Associate of the Linnean Society *honoris causa*. He was appointed as Honorary Lecturer in Systematic Botany in the University of Adelaide from 1927.

He was awarded the Verco Medal of the Royal Society of South Australia in 1930, the Mueller Memorial Medal of the Australian and New Zealand Association for the Advancement of Science in 1932, the Australian Natural History Medallion (Field Naturalists' Club of Victoria) in 1944, and the Clarke Memorial Medal of the Royal Society of New South Wales in 1946. He received the honour of M.B.E. in 1942.

Among the latest new species to be described by J. M. Black is *Bulbostylis eustachii*, a sedge from the Evarard and Musgrave Ranges. This was collected by his second son, Dr. Eustace C. Black, in April 1930 and named after him. The description has not yet been published but will appear in the ' Additions ' incorporated in Part III of the *Flora*. His daughter predeceased him but two other sons survive with grandsons and great-grandchildren.

J. B. CLELAND.

It was almost by accident that **William Williamson,** joint author with C. D. Soar of the Ray Society's monograph on British water-mites, took up the study at which he became an acknowledged expert. He was born in Leith in 1869, had no scientific training, and spent practically all his working life in the employment of the Scottish American Mortgage Company of

Edinburgh, in which he rose to be chief clerk, with very considerable responsibilities in the handling of the real estate business of the Company.

He showed no special bent in his early years for the study of natural history, but he was an omnivorous reader, and in the miscellany from which he stored his mind, he encountered, at the age of thirty, the articles on British water-mites which C. D. Soar was then contributing to *Science Gossip*. Williamson set about collecting these miscroscopic inhabitants of ponds, found that he could readily identify them with the aid of Soar's detailed descriptions, and soon got into touch with Soar himself. This was the beginning of a friendship which lasted until Soar's death almost forty years later, and it provided a stimulus which turned the hesitating amateur into a skilled collector and accomplished microscopist.

He described his own collections of water-mites from several Scottish localities, named the collections made during Murray and Pullar's *Survey of Scottish Fresh-water Lochs*, revised the early lists of Johnston from Berwickshire and Dalyell's *Scottish Hydrachnids*, and described several new or rare species. Then the two amateurs, Soar and Williamson, arranged to collaborate in the production of a work which is a lasting monument to both—the Ray Society's three-volume monograph on *The British Hydracarina*. The volumes appeared in 1925, 1927 and 1928, Soar being entirely responsible for the beautiful figures and Williamson taking main responsibility for the synonymy and descriptive text.

Williamson was a Fellow of the Royal Society of Edinburgh and of the Royal Microscopical Society as well as of the Lnnean Society (elected in 1916) and for many years he was active as an office-bearer of the Royal Physical Society of Edinburgh. His latter years were clouded by ill-health, but he remained full of interest in his books and in his water-mites until his last illness. He died in Edinburgh on 19 December 1950, his wife having predeceased him by a few months.

JAMES RITCHIE.

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1950–51

Note.—Names of donors are given in square brackets. Separate copies of papers which are included in periodicals received by the Library are no longer catalogued.

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BENEFACTIONS

LIST *in accordance with Bye-Laws, Chap.* 17, *Sect.* 1, *of all Donations of the amount or value of Twenty pounds and upwards, received during the past five years.*

1947

The Royal Society : Grant-in-aid of publications, £750.
Anonymous Donor : Towards the reorganization of the Library, £100 ; and two mahogany bookshelves.
Mr. Reginald L. Hine, F.S.A. : Manuscript botanical note-book written by Thomas Lawson in 1676–77.

1948

The Royal Society : Grant-in-aid of publications, £750.
Dr. J. Jaramillo-Arango : Donation towards cost of plates for his paper in *Journal, Botany*, £45.
The Pilgrim Trust : Grant to form the nucleus of the Library Restoration Fund, £2500.
Royal Academy, Inverness : Copy of Thornton's *A new illustration of the Sexual System of Linnaeus.*
Imperial Chemical Industries : Donation to the Library Restoration Fund, £50.
Royal Horticultural Society : Donation to the Library Restoration Fund, £105.
Zoological Society of London : Donation to the Library Restoration Fund, £25.
Dr. G. H. Pethybridge : Bequest for general purposes, £100.

1949

The Royal Society : Grant-in-aid of publications, £750 ; Grant-in-aid of the Library, £250.
Mrs. C. M. Snow, F.L.S. : Donation to the Library Restoration Fund, £30.
Colonel F. C. Stern, O.B.E., M.C. : Donation to the Library Restoration Fund, £45.
Mr. A. E. Günther : 42 volumes of the late Dr. Albert Günther's work books, with a book-case.
Imperial Botanical Conference Trustees : Donation to the Library Restoration Fund, £57 4*s.* 11*d.*
Anonymous donor : £25 to the Library Restoration Fund.
The late Mr. R. J. Flintoff, F.L.S. : £1000 free of Legacy Duty.
Research Committee of the University of Liverpool : Donation towards the cost of Dr. C. Leighton Hare's paper on *Eriocaulon*, £25.
Miss I. M. Hayward : Bequest of £100 for general purposes.
Mr. D. J. Scourfield, I.S.O. : Bequest of £100 for general purposes.

1950

The Royal Society : Grant-in-aid of publications, £750.
Miss E. F. Noel : Bequest of £100 for general purposes.
Mr. E. A. Robins : Long run of the Society's publications.
Mr. W. C. Barton : Long run of the Society's publications.
Mrs. E. W. Sexton : Donation towards the cost of the joint paper on *Jassa* in the *Journal, Zoology*, £50.

1951

The Royal Society : Grant-in-aid of publications, £750.
Mr. James Insch, F.L.S. : Bequest of Library of works on Tea.

THE SYSTEMATICS ASSOCIATION

ANNUAL REPORT X (1950–51)

The Ninth Annual Report for the year 1949–50 was adopted at the Annual General Meeting held on 5 May 1950 in the Herbarium, Royal Botanic Gardens, Kew, at the invitation of the Director. The formal meeting was preceded by a demonstration on the methods of botanical taxonomy which was well attended.

A discussion on " Phylogeny in relation to classification " was held in the rooms of the Linnean Society on 14 December 1950 at 5.0 p.m. This was opened by Prof. A. A. Boyden, Rutger's University, New Brunswick, life-member of the Association, and by Dr. E. J. H. Corner, Botany School, Cambridge. This was followed by a lively discussion. An account of the meeting has been published in *Nature*, **167,** 31 March 1951, 503–505.

A joint discussion with the Linnean Society on the " taxonomic treatment of biological races " was held in the rooms of the Linnean Society on 22 February 1951 at 5.0 p.m. The principal speakers were Mr. B. L. Burtt (flowering plants), Dr. C. A. Hoare, F.R.S. (parasitic Protozoa), Dr. R. W. G. Dennis (Mycology), and Mr. P. F. Mattingly (the *Culex pipiens* complex). A full report of this discussion will be published by the Linnean Society.

Following a suggestion made at the demonstration of Botanical Taxonomy at Kew last year, a " Northern Committee of the Systematics Association " has been set up. This Committee has organized a discussion on " Evolutionary trends and classification " held in Leeds City Museum on Saturday, 28 April 1951. The following papers were included : " Units of evolution and units of classification " by Dr. J. M. Thoday (Sheffield) ; " Evolutionary trends and classification in the Bryophyta " by Professor P. W. Richards (Bangor) ; " Trends in the degree of diversification of Diatoms " by Professor J. Small (Belfast) ; " Is phylogenetic speculation necessary to the practising taxonomist ?" by Dr. O. W. Richards (Slough) ; " The evolution and phylogeny of the insecta with special reference to classification of the Homoptera–Psyllidae " by Dr. G. Heslop Harrison (Newcastle) ; " Some problems in invertebrate palaeontology " by Dr. R. M. C. Eagar (Manchester) ; " Taxonomy and evolution in very polymorphic species " by Dr. A. J. Cain (Oxford).

Activities of Committees.

(a) *Research.*

Mr. B. L. Burtt has received and dealt with a number of inquiries with regard to subjects suitable for research.

(b) *Maps and Censuses.*

There is little further progress to report. The vice-counties maps are not yet ready for publication. Blocks of experimental maps of tropical Africa have been made on the basis of work done at Kew Gardens.

(c) *Education.*

No meeting has been held during the year.

(d) *Taxonomic Principles.*

Mr. Alston organized a very successful discussion in committee of the late Mr. Wilmott's paper on " Infra-specific categories " : one result of this discussion was the Joint Meeting with the Linnean Society on Biological Races reported above. Preliminary steps have been taken towards the production of a successor to the *New Systematics.*

(e) *Handbooks.*

Key Works is ready for the press. The botanical section has been completely rewritten and a small addition on Pollen Analysis is now included.

The second set of lectures by the Linnean Society in conjunction with the Systematics Association 1949–1950 " On the Practice of Botanical and Zoological Classification " has now been published by the Linnean Society, 1951. Price 4/–.

J. P. Harding,
R. Melville.
Hon. Secretaries.

THE SYSTEMATICS ASSOCIATION

ANNUAL REPORT XI (1951–52)

The Tenth Annual General Meeting was held on 4 May 1951 at the Herbarium, Royal Botanic Gardens, Kew, by kind permission of the Keeper, Dr. W. B. Turrill. The Tenth Annual Report was adopted and is being published in the *Proceedings of the Linnean Society.*

By invitation of the Director, Sir Edward Salisbury, at the conclusion of the business meeting, members inspected and discussed a series of exhibits in the Herbarium illustrating various problems and techniques in botanical taxonomy.

A well attended Joint Meeting of the Association with the Linnean Society took the form of a discussion on " Growth and Systematics ", held in the Rooms of the Linnean Society on Thursday, 20 March 1952. The discussion was opened by Professor W. E. Le Gros Clark with a paper on " Growth in relation to the Systematics of the Primates ", followed by Dr. R. M. C. Eagar who spoke on " Relative growth in Shells of the Fossil Family Anthracossidae during the Carboniferous Period ", and Dr. R. Melville on " Growth in relation to Plant Systematics ". A general discussion followed. A full account of the meeting will be published in the *Proceedings of the Linnean Society.*

The Northern Committee of the Association, convened by Dr. H. G. Baker, organized a meeting to discuss the " Taxonomic Treatment of Ecological Races". At the invitation of Professor D. H. Valentine, this was held on 9 February 1952 at 2.30 p.m. in the Department of Botany, University of Durham, and was attended by a number of members and visitors from Northern, Scottish and Belfast Universities. The good attendance and the animated discussion that ensued provided further justification for provision of provincial meetings. A very full account of the meeting held at Leeds in 1951 was published in the *Proceedings of the Leeds Literary and Philosophical Society* and reprints will be distributed to members as soon as available. Reprints of the discussion on " Phylogeny in Relation to Classification ", *Nature,* **167,** 503, and " A Joint Discussion with the Systematics Association on Biometrics and Systematics ", *Proc. Linn. Soc.* **162,** 1949–50, 153–178, have been distributed.

The reorganization of the work of committees has been discussed by Council as it was felt that some of them had fulfilled their purpose and should be disbanded. In the light of changing conditions, it was decided that the purposes of the Association might often be better served by the appointment of temporary panels to undertake specific tasks rather than by permanent committees. The existing committees have been dealt with as follows :

(a) *Research.* Only the botanical section of this committee has been active. Mr. B. L. Burtt at Edinburgh has been asked to continue to maintain the card index relating to taxonomic research on the British flora in collaboration with

Mr. R. D. Meikle at Kew, a copy to be kept at both centres. The Zoological Secretary agreed to direct enquiries concerning zoological research to appropriate persons.

(b) *Maps and Censuses.* The work of this committee was not yet completed as it had to arrange for the publication of the Vice-Counties maps. Mr. Dandy had nearly finished his work and it was hoped that publication could be undertaken by the end of the year.

(c) *Education.* As a result of altered conditions, it does not seem desirable to proceed further with the textbooks that were to have been sponsored by this committee, except for the more advanced book on botanical taxonomy. It was decided that the present committee should be discontinued and a panel consisting of Dr. W. B. Turrill, Mr. S. M. Walters and Mr. J. E. Dandy should be formed to consider the best methods of dealing with this project and to report back to Council.

(d) *Taxonomic Principles.* This committee has a large body of data on infra specific categories which was collected while the late A. J. Wilmott was convener. During the year Mr. P. C. Sylvester-Bradley has undertaken the convenership in place of Mr. Alston, who was in indifferent health. The data have been collated, and a meeting was held on 11 March 1952 in the Board Room of the British Museum (Natural History) to discuss the classification and coordination of infra specific categories with a view to subsequent publication. A glossary and preliminary attempt at classification had been drawn up by the convener, and circulated to members before the meeting. Fourteen members were present, and written contributions were sent by a number of others. Both botanists and zoologists were well represented. Dr. Turrill was elected to the chair. A substantial measure of agreement was reached as to the principles which should be adopted as the basis of such a classification. Mr. Gilmour was asked to prepare a schedule of categories for discussion at a future meeting. It has been agreed that the glossary and preliminary classification of infra specific categories shall be circulated to all members of the Association with an invitation to take part in any future discussions on the subject if they so desire.

(e) *Handbooks.* It was agreed that this committee has fulfilled its purpose and should be dissolved. In the future, publications will be handled by panels appointed for the purpose as required.

There were 191 members of the Association on 30 April 1952, of whom 36 were life or founder members.

J. P. Harding,
R. Melville,
Hon. Secretaries.

THE SYSTEMATICS ASSOCIATION: ACCOUNTS FOR THE YEAR 1950–51

ORDINARY ACCOUNT. (Balance taken on 1 May 1951)

INCOME

	£	s.	d.
Balance at the Westminster Bank on 1 May 1950	178	16	11
Subscriptions	33	10	3
Sale of *Key Works* (2 copies)		12	6
Royalties of the *New Systematics* (for year ending 31 March 1950)	60	3	3
Received in respect of report on a meeting of the Association published in *Nature*	1	18	0
	£275	0	11

EXPENDITURE

	£	s.	d.
Outstanding from 1950 :—			
Secretarial expenses	4	12	0
Treasurer's expenses		11	0
Secretarial expenses (1951)	7	4	4
Transferred to Special Fund	5	0	0
Director General of Ordnance Survey (maps required for Mr. Dandy's work for the Association)	3	4	8
Linnean Society (reprints)	12	7	9
Nature (reprints)	1	15	0
Balance at the Westminster Bank on 1 May 1951	240	6	2
	£275	0	11

	£	s.	d.
Outstanding :—			
Treasurer's expenses	1	1	3
Subscription for Affiliation with Leeds Philosophical and Literary Society	1	1	0
Mr. P. C. Sylvester Bradley (expenses in connexion with organization of Leeds meeting)	2	13	2
	£4	15	5

SPECIAL ACCOUNT. (Balance taken on 1 May 1951)

INCOME

	£	s.	d.
Balance in Post Office Savings Account on 1 May 1950	340	18	11
Life Membership Subscriptions (5)	25	0	0
Transferred from Ordinary Account	5	0	0
Donations		5	0
Interest	8	11	6
	£379	15	5

EXPENDITURE

	£	s.	d.
NIL			
Balance in Post Office Savings Bank on 1 May 1951	£379	15	5

E. B. BRITTON, *Hon. Treasurer.*

Audited and found correct :—

V. S. SUMMERHAYES, } *Hon. Auditors.*
B. L. BURTT,

3 May 1951.

THE SYSTEMATICS ASSOCIATION : ACCOUNTS FOR THE YEAR 1951–52

GENERAL ACCOUNT. 1951–52

INCOME

	£	s.	d.
Balance at Westminster Bank on 1 May 1951	240	6	2
Clarendon Press : royalties on *The New Systematics*	22	9	5
Annual subscriptions	31	0	0
	£293	15	7

EXPENDITURE

	£	s.	d.
Outstanding from 1951 (as per last account) :—			
Britton : Honorary Treasurer's expenses	1	1	3
Leeds Literary and Philosophical Society	1	1	0
Sylvester-Bradley : organization of Leeds meeting	2	13	2
Cheque book		10	0
Harding : Honorary Zoological Secretary's expenses	4	7	6
Couldrey & Co. : duplicating paper	5	18	6
Leeds Literary and Philosophical Society	1	1	0
Baker : Northern Discussion Group, Durham	1	3	6
Sylvester-Bradley : Taxonomic Principles Committee	4	12	11
Publications distributed to members	—	—	—
Balance at Westminster Bank on 30 April 1952	271	6	9
	£293	15	7

SPECIAL ACCOUNT. 1951–52

	£	s.	d.
Balance in Post Office Savings Bank account on 1 May 1951	379	15	5
Life membership (1)	5	0	0
Interest 1951	9	10	1
	£394	5	6

	£	s.	d.
Sundry expenditure	—	—	—
Balance in Post Office Savings Bank account on 30 April 1952	394	5	6
	£394	5	6

BALANCE SHEET. 30 APRIL 1952

	£	s.	d.
Founder and Life Members (36)	180	0	0
Annual subscriptions in advance (84)	21	0	0
Sundry creditors :—			
Honorary Treasurer	2	3	1
Honorary Zoological Secretary	10	19	0
Honorary Botanical Secretary (est.)		5	0
Excess assets over liabilities	460	11	2
	£674	18	3

	£	s.	d.
Balance in Post Office Savings Bank	394	5	6
Balance at Westminster Bank	271	6	9
Subscriptions—1 year in arrear (39 at 4/-)	7	16	0
Subscriptions—2 years in arrear (15 at 2/-)	1	10	0
Stocks of books	—	—	—
	£674	18	3

G. J. KERRICH, *Hon. Treasurer.*

Audited and found correct :—

V. S. SUMMERHAYES, } *Hon. Auditors.*
E. MILNE-REDHEAD, }

5 May 1952